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Engineering News-Record

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First Test of Miami Flood Control Works

Highest Stage of Water Since the Big Flood of 1913 Safely Handled

(See Picture)

Progress of the Major Street Plan in St. Louis

Twelfth Street to be Widened to 100 feet for Length of 6½ Miles

By Harland Bartholomew

Aggregate Proportioned for Equal Strength Concrete

By A. N. Johnson

A Call for a Practical View of Structural Teaching

By Edward Godfrey

Unwatering Lock Site of New Orleans Harbor Canal

By George R. Goethals

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"The Paving that's Saving"

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 84 — NEW YORK, THURSDAY, MAY 13, 1920 — Number 20

How Will They Work?

MULTIPLE hopper bottoms for sewage sedimentation basins are no longer a novelty but their use for water settling basins is rare if not new. In the coagulation basin at Atlanta, Ga., described on p. 958, such a bottom is used for the inlet end of the basin. News of the practical working of this design will be awaited with interest.

City Planning Progress at St. Louis

STEADY progress is being made in carrying out the street widenings and openings designed by the St. Louis City Planning Commission to give that city a street system adapted to traffic needs. The general scheme, with an outline of the work thus far accomplished is presented on p. 954. St. Louis deserves credit for its persistent and consistent city-planning work. Its major traffic plan and its zoning system put it at the very forefront in city planning activities.

Wrapped Garbage

HOWEVER well the practice of wrapping garbage in paper before putting it in the cans may have worked at Minneapolis while the garbage was incinerated it appears from the note printed on p. 907 of our issue of May 6 that it has caused the hog-feeding contractor much trouble. Not only is the bulk of material to be handled largely increased but in addition there is a vast quantity of paper to be gathered up in the feeding places. Burning this in the open air has caused trouble. It always was a question in the minds of some whether the Minneapolis health department could not have got more health benefit from an equal amount of work put on something besides educating housewives to wrap their garbage—and tie it with a pink ribbon, the facetious have said.

The 1920 Road Program

MR. PIEPMEIER'S article on p. 949 of this issue indicates graphically the lapse between the time highway contracts are entered into and the time work upon them commences. As chief causes for the delay he assigns inability of contractors to secure adequate plant, shortage of material, shortage of labor, labor strikes and lack of transportation. To correct these conditions research has been carried on by many states on the availability of local materials. A general appeal went forth late in 1919 from the Bureau of Public Roads urging state highway departments to "let highway contracts early in 1920." Contractors have been busy during the winter adding to equipment. But the greatest of all deterrents to the successful prosecution of highway programs remains—for labor is even more volatile in its 1920 demands, and railroads are finding it difficult to transport perishable freight. The case of Illinois is typical, and we can see in the 1920 highway program only a restriction in new construction to those jobs where materials and labor are locally ample, or where commercial motor traffic demands new construction at any cost; and the exercise, in maintenance, of super-skill.

Innocent Until Proved Guilty

THE time has gone by in Chicago when public officials can suspend engineers in public service without notice being taken of that fact by the engineering societies. The Western Society of Engineers has a civic committee looking into the suspension of two engineers in the bridge department. A similar committee of the Chicago Chapter of the American Association of Engineers has concluded an investigation, and the chapter May 7 approved a set of resolutions drawn up by its committee condemning the action of the officials "in besmirching the character" of the engineers by publicity of unproved charges and offering them the moral support and backing of the chapter. Statements in the letter suspending the engineers charged them with removing bridge plans, specifications and other papers from city offices for the use of a bridge company with which they were connected. Much publicity was given to this letter but the engineers feel that they are not in a position to answer the allegations until formal charges are made before the Civil Service Commission. It is certain both societies will follow the procedure closely and therefore the engineers are assured of not being condemned by their brother engineers, even for political purposes, until proved guilty.

Technical Articles in Newspapers

ENGINEERING information is served regularly to newspaper readers in some foreign countries and it has its effects. Industrial developments of all kinds in the Scandinavian countries are due largely to the foresight and vision of the daily papers, which are keen and eager to give their readers authentic articles on technical and scientific matters—the only way by which a true public interest can be created for the intelligent industrial development of the country. J. W. Dyckman, a metallurgical engineer of San Francisco, made the foregoing statement in April before the American Electrochemical Society in explaining the rapid utilization of water power in Norway, a financially poor country with a small population. A recent London daily contained more than two columns on foundations, in which the author-compiler, an engineer, started with the conditions in Chicago, skipped to Australia, to South America, the Continent and back again to London. There was absolutely no news value in the foundation story nor any attempt made to inject news. It was a solid informative digest on foundations, such as an engineer, not a foundation expert, would like to read. The problem

of educating the American public through the newspapers is one still ahead of the engineering profession. Here is a task that awaits the new federation of engineering societies.

Using Available Aggregate

THE tabulation of concrete proportions in A. N. Johnson's article on another page is the most practical application of the various new concrete-mix theories that has yet appeared. Based though it is on Professor Abrams' elaborate series of tests and his fineness modulus theory, its application lies in the very prosaic but most important problem of utilizing an available aggregate or of balancing the cost of two kinds of aggregate. The "artist stuff" is all omitted, though without it the tables could never have been developed. For any given aggregate a concrete of desired strength can be obtained with the stated proportions. The user need know nothing of fineness modulus, surface area, or other laboratory constants; all he has to do is to find the grading of his aggregate and to be sure that the concrete is made to the required proportions and of a "practical workability." Unfortunately that last term is still indeterminate, in spite of the several gages which have been proposed, but it is no more indeterminate for a 1:2.6:4.3 mix of hitherto rejected aggregate than it is for a 1:2:3 of Fuller-curve material. The proof of the usefulness of the tabulation is in the actual strengths of the concretes so made. If, as the Abrams' experiments show, the proportions there stated will give a concrete which tests as consistently around 3,000 lb. per sq.in. as a standard 1:2:3 mix, under usual conditions of production and with the same criterion of consistency, its application is manifest though limited. To insure better and cheaper concrete by observance of aggregate grading and adherence to a proved consistency measure is a step beyond, which this practical application does not fully reach.

A Halt in New York's Highway Program

HIGHWAY builders throughout the country will at once recognize the significance of the statement of Commissioner Greene, of the New York State Highway Department, appearing in the news pages this week. A decisive step has been taken. In addition to withdrawing all roads advertised for new construction in the letter of May 5, it is announced that "there will be no further new roads offered for construction until the situation shows a decided change for the better." A variety of reasons have combined to put into effect so drastic a policy. Chief among them are the shortage and high cost of labor, shortage of transportation, lack of competition in bidding and advances in prices of materials. If the announcement meant that New York had, for a time at least, suspended road construction the situation would be alarming. This, however, is not the case. The State has in hand 183 uncompleted but active road construction contracts involving about 600 miles of unfinished work, to say nothing of extensive maintenance required on other routes. Commissioner Greene points out that under present conditions the undertaking of new enterprises on a large scale would create a situation forcing contractors on the new and on existing contracts to bid against one another at ever increasing prices. The suspension of all new work, the Commission feels, is the only solution to the present difficult problem. *Engineering News-Record's* attitude regarding this year's highway construction program was stated March 4, p. 451. Here the wisdom of curtailment of highway work to reasonable dimensions, in order that promises to the public might be fulfilled, was advocated. New York State has gone a step farther. Instead of curtailing, it has suspended new work. In the light of what has happened in New York a reading of the editorial above referred to is worth while. In its bearing on the general situation, also, the announcement in this week's news pages to the effect that the General Contractors' Association is beginning an inquiry into material prices is worth noting.

Status of Vehicular Tunnel

THERE is encouragement in last week's news to the effect that although the Governor of New Jersey has vetoed the bill authorizing funds for the construction of the vehicular tunnel between New York and New Jersey, the measure may be passed over his head. In fact, the Assembly has already taken affirmative action, and it is expected that the Senate will follow suit this week. So much for the New Jersey end of the project. On the New York side the Legislature has approved an initial outlay of $1,000,000 and the bill carrying this appropriation is now awaiting the signature of the Governor. It is believed that there is little likelihood of its non-approval. It is high time to put the vehicular tunnel work under contract. There has been more than enough talk about this project. A half dozen public hearings afforded engineers and laymen alike an opportunity of expressing their views and the minutes of these meetings, while they may bring out, here and there, a point of interest, are in reality a huge volume of verbiage of no particular value in the planning or the conduct of the work. The project is one of such importance to both states concerned that construction should be started forthwith. With twin tubes under the Hudson, strikes of ferryboat operators, lighterage employees, stevedores, and other water-front and terminal personnel would cause much less concern than at present. There would always be available an open route for the transport of freight and produce by motor truck between Jersey and New York. As shown conclusively in the chief engineer's report, the vehicular tunnels will be more than self-supporting—estimates indicate that they will return a handsome profit on the investment. Under these circumstances the precise manner of providing funds for the tunnel construction, while it may be an interesting subject of discussion for economists, is merely holding up much needed work. The time for talking has passed. The time for actual digging has arrived. It is hoped, therefore, that the executives of the States of New Jersey and New York will place no obstacles in the way of an early start on this important public improvement.

Municipal Engineers' Compensation

A MOVE in the right direction was made, as reported in last week's news, when the Municipal Engineers of the City of New York invited to their regular meeting the Comptroller and the Civil Service Commissioner in order that these public officials might learn at first hand the attitude of engineers in the city's service toward the present salaries that are being paid. In the past many engineering societies have discussed the

subject of compensation among their own membership. While some results are to be expected from such meetings, in the way of arousing sentiment, they are, if taken alone, ineffective because they do not reach the people who have the power to change conditions. The New York engineers, however, presented their case to the city officials with direct influence to adjust rates of compensation. It would be a good thing if more engineering organizations took the opportunity to bring the membership into closer contact with elective or appointive public officers. Evidence that this procedure is being followed more and more is developing every week. By acquainting public officials not only with the real conditions in the profession, but with engineers themselves, technical men are not merely serving their own selfish ends but are working for the best interests of the municipality. A reading of the extracts from Mr. Ridgway's address before the Municipal Engineers, appearing elsewhere in this issue, indicates conclusively that city engineering organizations everywhere are being broken up by the withdrawal of good men and by a general lowering of the morale among those that remain. While at the present time there is no great activity in public works construction, due to the high prices of material and shortage of labor, the time will come when the great volume of delayed improvements which have piled up must be put through. Skilled engineering personnel will then be needed if the work is to be done well and economically. City officials who fail to see far enough ahead to recognize this situation will have a rude awakening. Now is the very time when city engineering organizations should be held together and it is a short-sighted policy which fails to provide adequate compensation for the retention of the best men in the service.

University Faculty Salaries

THE financial status of teachers in the University of Illinois, ascertained by a questionnaire handled by the Federation of Teachers, indicates an alarming situation in one of the strongest Middle Western state institutions. Rumbles of dissatisfaction because of inadequate salaries in the state universities are heard with increasing frequency. One of Iowa's institutions has had difficulty in holding its personnel and no doubt the same condition exists to a certain extent in all schools.

Campaigns for increased endowments of schools outside of the state institutions have made sufficient headway to inform most people that educational staffs have learned all about the shrunken value of the dollar. Exact statistics, however, have not been published widely, and the University of Illinois figures are illuminating, since they represent answers from 40 per cent of the 400 members of the teaching staff. Notwithstanding their longer term of service and advancement in rank, an overwhelming majority of members of the faculty are worse off financially than they were six or seven years ago. Not a few men intimate that they will soon be compelled to accept attractive offers elsewhere unless the situation is relieved. The report clearly indicates that two-thirds of the married instructors, three-fourths of the assistant professors having more than one child and one-half of the full professors having more than two children cannot and do not live within their salary. To avoid a deficit all ranks have usually had to resort to most rigid economies and to cut far below any reasonable minimum the amounts allowed for savings and professional expenditures. As a natural result there is little room for that buoyancy and enthusiasm, that combination of free play and concentration of mind essential to growth and success in intellectual life.

The significant fact is that hordes of graduates are being turned out to whom practically free instruction has been given. Who pays for this generosity? Is not too great a portion of it taken from the pockets of the instructors who for loyalty or a desire to retain work for which they are fitted, or perhaps for lack of salesmanship or business ability, stay on year after year at less than a living wage?

Leaky Cross-Connection Kills Fifteen

THE foregoing title and a corresponding story should have appeared in the newspapers of Bloomington, Ill., following a typhoid outbreak at the Chicago & Alton shops, which State Board of Health officials traced to a leaky valve in a cross-connection between the city supply and that furnished for industrial uses at the shops. The creek supply for the shops gave out, a 33-in. outlet sewer was tapped and the contents, consisting of sewage and creek water, led into the suction well from which the industrial supply was pumped. The leaky valve admitted the polluted water to the city mains that supplied city water for drinking purposes in the shops.

This epidemic did not occur during the war emergency two or three years ago, nor in Bolshevistic Russia. It happened in January, 1920, in the heart of the Middle West, in the State of Illinois. Details of the piping system will not be found elsewhere in this issue because there is nothing new or complicated to relate. The official who made the investigation apparently has become so hardened to the usualness of the occurrence or perhaps to the hopelessness of ever expecting anything different that he concludes his report in these words: "The situation at Bloomington is only one more reminder of the dangers of permitting connections between two supplies, one of which is of safe quality and the other unsafe or questionable. Several Illinois cities have already paid dearly for their experience along these lines and no time should be lost by others similarly situated, to have such connections removed." At least 15 dead from typhoid fever, 130 cases and between 300 and 400 down with severe intestinal disturbance: That is a casualty record which if it had occurred from a race riot, a cyclone or a Mexican raid, would have claimed space in every newspaper of the country, with demands that the guilty parties be held responsible. But this calamity is unnoticed in the press, and some time afterwards another eight-page typewritten report is filed in the archives of the Board of Health, while the guilty go scot free. A few gentle taps on the wrist are administered no doubt, but what assurance have the 2,000 shop workers in Bloomington that the two systems will not again be connected when water is short and there is a handy sewer to tap?

Unfortunately there are still some engineers, especially those in the employ of the fire insurance companies, who see no harm in cross-connections or who put property risk above life risk. Some day sanitarians will ask organized labor to help them get through real legislative safeguards in this line with adequate enforcement provisions and drastic penalties for breaking the law.

Unwatering the Lock Site of New Orleans Harbor Canal

Sheetpile Cofferdams, Driven in Successive Rows Nearer and Nearer to Lock, Cut Off Porous Underlying Quicksand Strata Which Are Tapped With Flowing Wells as Dams Close In

BY GEORGE R. GOETHALS
Vice President, Geo. W. Goethals & Co., Inc., Consulting Engineers,
Board of Commissioners, Port of New Orleans, Louisiana

GROUND conditions in the alluvial plain at New Orleans are anything but favorable for the construction of large sursurface structures such as the lock now being built for the Inter Harbor-Navigation Canal. The ground level is about El. +25 (Cairo datum) with the river, from which the city is protected by levees, varying between +19 and +39. Underlying about 22 ft. of alluvial deposit are alternate layers of clay and flowing sand, the latter being water bearing but self-contained owing to the seal made by the clay. In this ground there has to be built the lock, a concrete structure 1,035 x 130 ft. in plan with its lowest part at El —22 and its highest at +45. The instability of the ground and width of the open excavation required made inadvisable cross-braced sheathing for the full height and the water-bearing strata indicated difficulty in keeping the hole dry. As a solution it was decided to make the excavation on a low slope by dredging, thus reducing the danger of slip, and to use a novel system of sheetpile cut-offs with drainage wells into the porous strata to keep the water from the excavation.

In brief, the method consisted in inclosing the excavation in a sheet-pile cofferdam reaching down through the first layer of flowing sand, driving inside of this dam a series of wells to the next lower porous layer, then a closer cofferdam cutting off this layer and again a series of wells into the next lower layer. Pumps at the wells kept the water leveled in the strata low enough so that the upward pressure on the bottom of the excavation was safe against flow out during the lowering of the water level inside the innermost cofferdam. Excavation under this method has been successfully completed and piles driven in the footing. Concrete for the lock is now being placed.

Fig. 1 is a cross-section of the lock side, showing a typical section of the lock, together with the nature and extent of various foundation sub-strata. The excavation was accomplished by means of hydraulic dredging. After the withdrawal of the dredge, a cofferdam was constructed at the north end of the lock to shut off the water in a partly finished section of the canal from the lock prism. The ground at the south end still remains intact.

All of the quicksand strata, being subject to static heads noted, required that certain safety precautions be taken before the water left in the lock prism, after the dredging had been completed, could be removed. The first step was to drive the outer line of wooden sheetpiling completely surrounding the lock, shown in the figure as cutting off the first or upper stratum of quicksand. The primary purpose of this was to maintain the water table in adjacent ground so as to guard against settlement of adjacent building foundations. The second stratum of quicksand, extending from El. —23 to El. —44 was next cut off by means of a wooden cofferdam 54 ft. in depth, and completely surrounding the lock. This is the inner wooden cofferdam shown in the figure. It was believed that this cofferdam, built of Martinez sheetpiling, would prove a sufficient safeguard to allow the water to be removed without further difficulty. To enable this cofferdam to be driven, the water in the lock prism was lowered to about El. +4 without difficulty.

In May, 1919, unwatering operation was resumed and everything went favorably until El. —3.5 had been attained. At this point, the bottom of the lock, at the south end, began to boil violently. This was accompanied by simultaneous movements of the banks at the

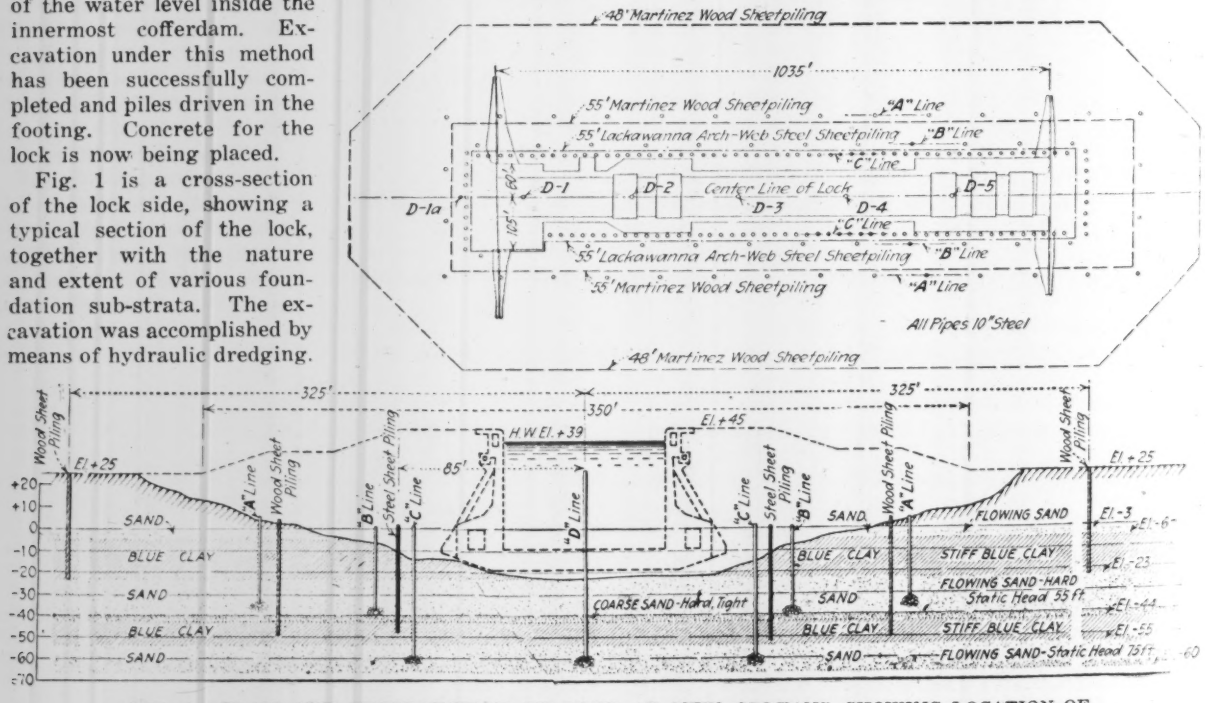


FIG. 1. PLAN AND CROSS-SECTION OF LOCK AT NEW ORLEANS, SHOWING LOCATION OF COFFERDAMS AND DRAINAGE WELLS

south end, and sides of the lock. The maximum movement occurred between the southeast corner and a point on the east bank 300 ft. north of said corner. Here the movement was sufficiently extensive to cause the line of sheetpiling to rupture for a length of 300 ft. and to move the broken section bodily for a distance of 25 ft. toward the center of the lock. This entire movement occupied an interval of approximately six hours and stopped entirely when the water was turned back into the lock prism and had risen about 6 in., bringing it back to El. —3. For safety, the water was carried up to an elevation of zero and maintained between El. 0 and —1.

This experience demonstrated the fact that the wooden cofferdam line was not adequately tight nor sufficiently strong to prevent the flow of quicksand under pressure through its interstices or to hold back tendencies of the banks to slide, unless further safety measures were undertaken. What undoubtedly happened to cause the slide above mentioned was this: As soon as the water in the lock was lowered below El. —3, the upper quicksand layer began to flow out into the lock prism. This caused the clay blanket lying above El. —3 to settle down to replace the outflowing sand. This vertical movement was accompanied by a natural tendency for the whole mass to move toward the center of the lock, which, in turn, caused the sheetpiling to rupture, allowing a movement of the second layer of quicksand through the ruptured sheetpiling, and causing the boiling noticed inside of the lock prism.

Following this slide, it was decided to construct a third cofferdam immediately outside of the lock masonry line, leaving enough space, however, for the later convenient handling of concrete forms. This cofferdam was of same depth as the inner wooden cofferdam but was constructed of Lackawanna interlocking steel sheetpiling. The ruptured length of the inner wooden cofferdam was re-driven. The steel cofferdam was braced transversely from side to side by means of heavy 10 x 10-in. timbers, fastened to and partially supported by piles driven for this purpose. In addition to bracing steel to steel, the steel cofferdam was likewise braced to the inner wooden cofferdam and provision was made for bracing the ends of both coffers against the system of transverse braces. The result was to form an incollapsible box, capable of resisting any pressure likely to be brought about by small bank movements.

On account of the tendency for the underlying quicksand strata to boil, and in order to prevent the flow of the quicksand in these layers, measures were taken to relieve the pressure in these strata by means of small artesian wells. To accomplish this, three lines of 10-in. pipe were driven entirely surrounding the lock.

The A line consists of 10-in. pipe driven on 100 ft. centers immediately outside of the inner wooden cofferdam and penetrating the quicksand stratum beginning at El. —23.

The B line is composed of pipe driven on 100 ft. centers, staggered with respect to the A pipe, located between the inner wooden coffer and the steel coffer, and penetrating into the same sub-stratum.

The C line is composed of 10-in. pipe driven on 20 ft. centers just inside of the steel cofferdam and reaching the quicksand stratum beginning at El. —55.

All of these pipe were cleaned out and filled for a few feet from the bottom with clean gravel to serve as a filter.

The intention was to keep the water in the A and B lines pumped out to an elevation of —18 ft. during the unwatering process. While the water in the lock was standing at zero, these pipe showed a small discharge at zero. It was demonstrated by experiment that the supply of water reaching the pipes in the A and B line was so limited that small duplex pumps, operating three A pipe and three B pipe each, would be capable of holding the water in these pipes at an elevation of —18, thus practically relieving the static head in the stratum in question.

The C pipe were to overflow at the same elevation at any time as the water in the lock prism. These developed a flow at zero, ranging from 4 to 7 gal. per min., which was greater than was found in the A and B pipe, but was to be expected on account of the deeper stratum into which the C pipe penetrated. The C pipe were tapped successively at lower elevations as the water in the lock was drained.

In addition to the foregoing, 5-in. 10-in. pipe were driven on 200 ft. centers along the center line of the lock penetrating the stratum beginning at El. —55, or, in other words, the same which the C pipe were intended to relieve. This latter line is known as the D line. The pipes of this D line were to serve as what might be called safety barometers to indicate the static head at any time in the lowest quicksand stratum. These pipes were not tapped anywhere and the water would rise in them to a height corresponding to the pressure below. It was to be expected that as the water in the lock prism fell and the C pipe were allowed to discharge themselves at successively lower elevations corresponding to the fall of water in the lock prism, the water in the D pipe would also fall. It was also expected that while the water in the D pipe would fall, it might lag somewhat behind the fall of water in the lock prism. In other words, the D pipe were to serve as possible danger signals during the unwatering operation. By assigning assumed weights of 100 lb. per cu.ft. to the material between the bottom of the lock excavation and the quicksand stratum at El. —55, and neglecting the frictional cohesion of this material as a resistent against any tendency of the blanket to rupture on account of boils, it was computed that if the elevation of water in the D pipe should ever be 18 ft. above the elevation of water in the lock prism a condition of theoretical equilibrium would exist between the weight of material overlying the quicksand stratum beginning at El. —55 and the upward thrust from this stratum, due to the presence of water under pressure. Stated in other words, if at any time the difference in elevation between water in the D pipe and water in the lock prism were less than 18 ft. there would be no danger of the bottom of the lock blowing up.

The foregoing additional safeguards occupied the construction time between May and the first of November, including six weeks of idleness on account of a strike.

On Nov. 18, 1919, the pumps operated by compressed air were started and from that date on the water in the A and B pipes was maintained at elevations varying from —15 to —18. For the first 10 ft., in anticipation of a possible movement of the banks, due to further

oozing of the upper quicksand stratum, the water was lowered approximately 1½ ft. on alternate days, and the other days were reserved for observation. The following schedule indicates rate at which water was lowered during this first period.

Date	Water Elevation Reached in Lock Prism
Nov. 19	—2.2
21	—3.5
23	—4.5
25	—5.5
27	—6.5
29	—7.5
Dec. 1	—8.75

At latter elevation pumping operations were discontinued to allow a supplementary line of bracing to be installed at El. —9. This was regarded as esesntial, inasmuch as the first system already described, lacked a proper amount of lateral stiffness. The new braces were placed immediately below the old set and connected thereto by means of cross-braces, thus forming a system of transverse trusses running across the lock and supported by the piles already referred to. These trusses were given lateral stiffness by means of occasional horizontal braces. It took from Dec. 1 to Dec. 24, 1919, to install this supplementary system of braces.

On Dec. 26 pumping operations were resumed and continued in accordance with the following schedule, it being regarded as unnecessary to suspend pumping on alternate days for observation purposes.

Date	Water Elevation Reached in Lock Prism
Dec. 26	—14.4
27	—12.5
28	—13.6
29	—14.5
30	—15.5

At this point pumping operations were suspended for three days in order to determine whether the lag in fall of water in pipe D-1 was due to local influence or otherwise. This will further be discussed below.

Pumping operations continued:

Date	Water Elevation Reached in Lock Prism
Jan. 3	—16.5
4	—17.5

During the unwatering process transit and level readings were taken twice daily on established points along the banks of the lock, and along the wood sheetpiling; level readings were also taken on points established on piles in the lock prism. The former were for the purpose of determining any tendency of the banks to [illegible], and the latter for the purpose of noting any tendency of the bottom to heave up. The inner line of wood sheetpiling moved toward a maximum distance of [illegible] in. Further movement was arrested by the braces. This movement was not accompanied by any bank movements visible to the eye and was noticeable by the transit readings only.

Attention is now invited to Fig. 2, which shows graphically the behavior of pipes in the D line during the unwatering program. It will be noted that the fall of water in the D pipe has practically been uniform with fall of water in the lock. In the case of pipe D-1, the peculiar condition noted between Dec. 12 and Dec. 20 is due to an abnormal condition resulting from disturbances around the bottom of the pipe produced by pile driving. The filter at the bottom of the pipe was undoubtedly damaged on account of the sudden jets produced under the blows of the hammer, and the water would be impelled into the pipe under this jetting, but fail to fall of its own weight through the damaged filter. When pile driving in the immediate vicinity of this D pipe had been completed, the water gradually fell, since which time the pipe has been acting normally. This was the reason for putting into service and starting pipe D-1-A, as it was not known whether pipe D-1 could be further relied upon.

Attention is also invited to the note at the top of this figure. This note explains the practically constant fall of the D pipe with respect to the water in the lock while latter was above an elevation of El. —10. On account of the mud line close to the steel sheetpiling where the C pipe were driven, it has been impracticable to tap the C pipe below elevation of El. —16. It was not feasible to do this until after Jan. 5. It takes some time to accomplish this punching, inasmuch as the mud has to be jetted from around the outside of the pipes, in order to make a tap at this elevation possible. This accounts for the lag and irregular behavior of the D pipe with respect to water in the lock after Dec. 26. At present the C pipe are being treated by tapping them at El. —16 with 1 in. pipe which are being laid laterally toward the center of the lock to a point where they can discharge freely without fear of being clogged due to future excavation processes. It was found impossible to jet around the C pipe and maintain the hole even in the stiff clay encountered. The hole would gradually fill up and the

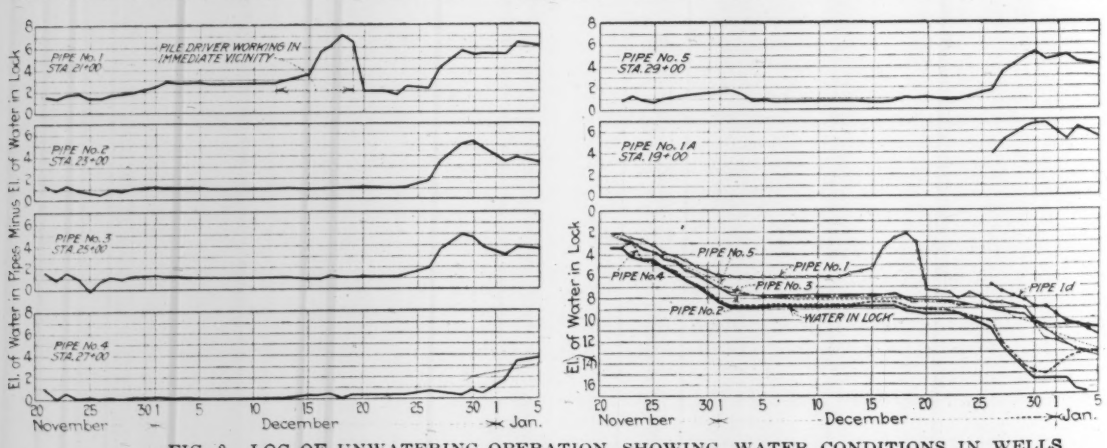

El. of Water in Pipes Minus El. of Water in Lock
PILE DRIVER WORKING IN IMMEDIATE VICINITY
PIPE No. 1 STA. 21+00
PIPE No. 2 STA. 23+00
PIPE No. 3 STA. 25+00
PIPE No. 4 STA. 27+00
PIPE No. 5 STA. 29+00
PIPE No. 1-A STA. 19+00
El. of Water in Lock
WATER IN LOCK
November
December
Jan.

FIG. 2. LOG OF UNWATERING OPERATION, SHOWING WATER CONDITIONS IN WELLS

orifice tapped in the pipe would become clogged. As this report is written, the water in all D pipe is gradually falling and will undoubtedly fall to within 3 ft., in all cases, of the elevation of discharge of the C pipe.

With water withdrawn to El. —17.5 practically all of the bottom of the lock prism is exposed. Not more than 2 in. of water remains. Material exposed is a soupy ooze into which a man will sink of his own weight for 3 ft. before bringing up on the hard material on which dredging stopped. It will be very easy to excavate this material by means of the centrifugal pumps that have been purchased for this purpose. Should the water be withdrawn at the present time this soupy material will quickly dry out and harden and would ultimately require jetting before removal by the centrifugal pumps; hence it has been deemed advisable to retain water elevation where it now stands, and then excavate the lock bottom by sections.

At the south end of the lock the bottom is higher than elsewhere but this was to be expected on account of the slide which took place in May, when a great deal of bank material slid in. The following table gives the average elevation of the bottom of the lock today on transverse sections taken every 100 ft. apart:

Instrument Station	Elevation of Bottom	
21	13.5	Hard material
22	17.5	
23	17.5	
24	17.5	
25	18.0	
26	16.5	
27	17.5	3 ft. to hard material
28	17.5	
29	18.0	
30	16.5	
31	17.0	

Bear in mind that the elevations noted in this table represent the top of the soft mud. The hard bottom occurs on an average of at least 3 ft. below elevations noted, in all cases except for the first three stations. Latter are at the south end of the lock, and elevations noted represent solid material. Very little of the latter will have to be removed, however, as most of it is outside the masonry line.

During the unwatering operation, it has been impossible to obtain any pipe flow data of sufficient value to go on record.

The pipes of the A and B lines, as has been stated, were connected up half a dozen to each pump. While effort was made to maintain the water level in these pipes at about El. —18, practically speaking it was almost impossible to regulate the speed of the pumps to make sure of this. For these reasons, the flow from any individual pipe could not be measured with any accuracy. It may be noted in passing that the supply of water reaching the B pipes was more limited than that which got to the A pipes. This was to be expected, however, for the reason that the portion of the stratum relieved by the B line was supposedly cut off by a wooden cofferdam. A phenomenon difficult to explain is the fact that the discharge from groups of A and B pipe at the north end of the lost—farthest from the river—is nearly double that from the groups at the south end.

Data on the C pipes is likewise lacking for the following reasons. When lowering the water in lock prism from El. —1 to —10, the C pipes were discharging through orifices punched at El. —10. Consequently the discharge could not be measured. During the second phase of the unwatering progress, the C pipe were punched every two feet or so and above the water level in the lock but there was not sufficient time to get discharge data. At present, with all C pipe punched at El. —16, it will be feasible to resume bi-weekly discharge readings. It is interesting to note that the C pipe system is so sensitive that punching a hole in any C pipe as much as one foot below the discharge orifices in the immediately adjacent C pipes practically stops the flow from the latter.

It should also be noted that during the majority of the time that the unwatering operation was taking place, the Mississippi River was at +33, or within 6 ft. of maximum recorded flood stage.

The methods employed to unwater the lock were devised by George M. Wells, of this firm, R. O. Comer, designing engineer, made many of the investigations and worked out many of the details in collaboration with Mr. Wells. J. Devereux O'Reilly was Chief Engineer up to Nov. 1, 1919. Under his charge, a large part of the details and safety devices for unwatering the lock were installed. General Arsene Perrilliat became chief engineer Nov. 1, 1919, and under his administration the actual unwatering operation took place. James Cosgrove was superintendent of construction during the entire time and was in direct field charge of all the installations and operations herein described.

Sand for Earth Road Maintenance

By N. S. Mullican
Highway Engineer, Davie Co., N. C.

In THE maintenance of earth roads there is no material so effective as quartz sand, if the road has a red clay base. It is not necessary to plow, disk and harrow the roadbed in order to effect a mixture of sand and clay, as has been the belief for so long among engineers using sand clay construction. The materials will effect their own bond when placed together and subjected to pressure due to traffic. Therefore, for the benefit of others who have problems similar to mine, I desire to give my experience in this method of road maintenance.

The road I have in mind, a 7-mi. section, had been originally given but a top-soil surfacing, which had been worn out with traffic and age, and had every appearance of being but an ordinary clay road, a type well known throughout the South. The first thing that was done was to machine the roadbed until the surface was brought to the required cross section and was perfectly smooth.

The coarse sand was taken from the creek bed nearby and spread upon the road in a 4-in. layer. The sand was spread evenly with a road machine and the road was then opened to traffic. After two or three days it was necessary to drag the road, for a great deal of the sand had been rolled to the shoulders. Continuing this frequent dragging, and especially after rains, the surplus sand would gradually disappear, being absorbed by the clay, until, at the end of 60 days, all the sand had been driven into the clay. Then another coat was applied, this time but 2 in. in depth, which was just enough to absorb any clay not absorbed by the first coat. This method of treatment has proved a most excellent and economical way of securing a smooth and more or less impervious surface which is capable of carrying fairly heavy traffic with a reasonable degree of maintenance.

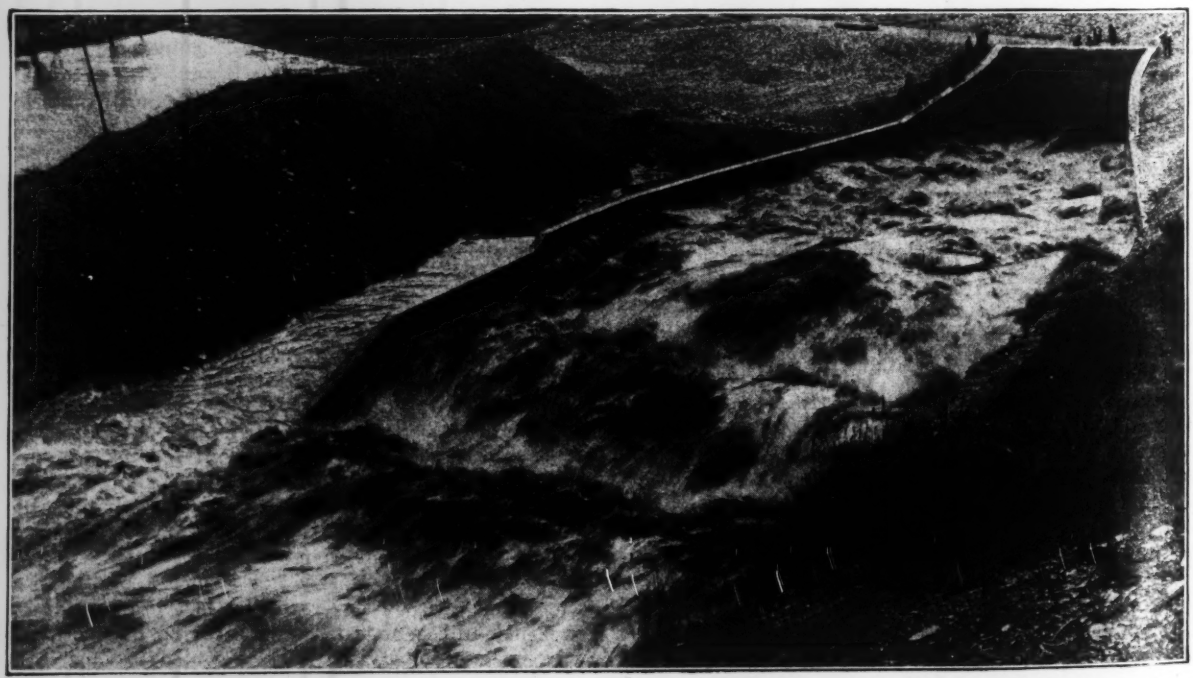
DISCHARGE AT GERMANTOWN DAM SHOWING JUMP IN POOL AND SMOOTH WATER BELOW

Highest Miami Flood Since 1913 Tests Conservancy Works

No Injury to Construction Work — Germantown Dam Impounds 25 Ft. of Water — Hydraulic Jump at Conduit Discharge

DURING the week April 18-24, 1920, the highest flood that had occurred in the Miami River since 1913 was experienced. No damage was done, and, in fact, the river did not reach the danger point anywhere along its length, but the flood supplied a test of the behavior of the uncompleted conservancy works that was of much value to the engineers. In particular the uncompleted Germantown dam on Twin Creek, now about 60 ft. high above river bed, was put under a head of about 25 ft. of water by the flood flow ponding back of it. The discharge conduits of this dam for the first time developed a well-defined hydraulic jump in the pool provided for that purpose at the outlet end, and thus gave the first full-scale verification of the effectiveness of the design. Such a test might have been obtained before this except for the fact that during the construction period, to guard against overtopping of the dam from flood ponding, the conduits have twice the cross-sectional area that they will have in their final service condition.

Two views of the discharge at Germantown are given in the accompanying photographs. The distant one gives a good picture of the downstream slope of the dam at its present height of 60 ft., and also shows the jump in the pool and the relatively smooth flow of



CLOSE-UP OF HYDRAULIC JUMP AT GERMANTOWN DAM, WHICH CONFIRMS EXPERIMENTAL STUDIES

water away from it. The other view, giving a "close-up" of the jump, shows in the background the flow out of the downstream end of the conduit and its rise in the jump. The latter will be seen to be a faithful duplication of the action studied in the miniature experimental apparatus used in working out the original design of the jump pools, as described and pictured in these columns three years ago (*Engineering News*, Jan. 17, 1917, pp. 144-151, see especially Fig. 13, p. 150). It is fair to say that in the present condition of the pool there is more disturbance in the jump and just below it than would occur later with a similar flood, due to the fact that the conduits are twice their final depth and that the lowered floor slopes up from the outlet end, reaching the permanent floor at a point some distance downstream from the end of the conduits, which tends to create marked irregularity of flow at about the center of the hydraulic jump pool.

At the Lockington Dam also the river channel is closed. A natural spillway has been left open at one side of the outlet structure to take care of the peaks of the larger floods which might occur during the spring's flood season. A little water passed through this spillway during the recent flood, but water was backed up behind the dam to a depth of 19 ft. A very well-defined jump occurred at this dam. The Lockington outlet structure is an example of the retaining-wall type which is in use at three of the Conservancy dams. The gap between the walls is left open during construction. Later, after the earth portion of the dam is completed to its full height, a cross dam will be built in between these walls, and the permanent conduit openings (two in number at this dam) will be left through the cross dam at the present river level. These contracted openings, of course, will give a different effect as to the jump, but from the indications given by this recent flood, it seems that the designs are sound.

At the approach and throughout the continuance of the flood the office of the Miami Conservancy District Engineering Department was the central point of information on rainfall and flow conditions and issued frequent forecasts. The forecaster, who was on the job continuously, was able to predict the river stage close enough for all needs 24 hr. in advance. A great many of the leading merchants in the larger cities depended wholly on the District advice in connection with moving goods out of their basements and lower floors. It was, in fact, not necessary to move anything, but probably a great deal of such work would have been done except for the confidence reposed by the people in the technical information supplied by the District.

There was no damage to speak of to any of the District construction work, although by far the larger part of it is in uncompleted condition. The high-water stages of the past two years merely held up the work in places temporarily, and did not essentially put the works to any test with respect to the effect of flow velocity and the like. The Germantown dam closure, and river diversion at Lockington, were accomplished late last fall and the present flood season therefore is the first in which the outlet works were called upon for real service. The engineers of the District are well satisfied with the outcome of the tests.

Skillful Underpinning Checks Warehouse Collapse

Eight-Story Brick Building Anchored Back, Jacked Up and Set on New Foundations While Loaded With Merchandise

By George F. Paul
Chicago, Ill.

REPLACEMENT in successive small units of the rotted pile foundations of a Chicago warehouse averted partial collapse of the building and, perhaps, obstruction by the ruins of the nearby channel of the Chicago River. A lowering of the water level since the foundations were constructed is the attributed cause of failure. Almost complete decay of the pile tops and grillage capping was disclosed when, after serious settlement of the building, the foundations were uncovered and unsuspected danger of sudden collapse appeared. The reconstruction restored the original secure condition of the building. A sketch of the building is shown by Fig. 1. It is an eight-story structure with brick walls, iron columns, steel floor beams and wood floors, and was built in 1872. Originally, the front wall was on line with the second row of columns, as indicated by the dotted line. After a fire in 1881, the building was widened 18 ft. its whole length, the addition being supported on pile-and-grillage column and wall footings built where the old wharf had been.

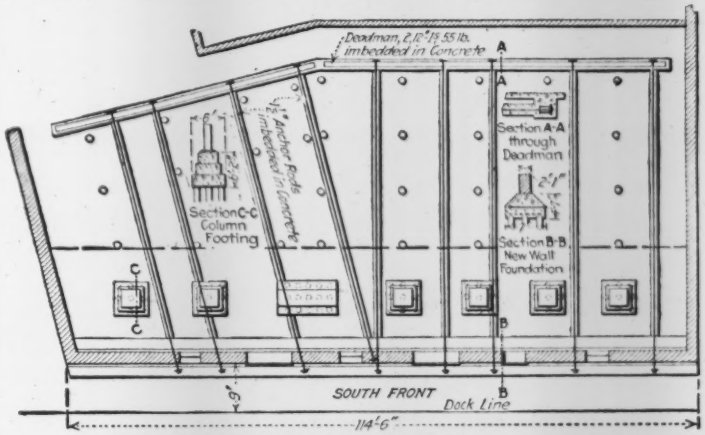


FIG. 1. PLAN OF UNDERPINNING AND ANCHORING SETTLED PART OF WAREHOUSE

Settlement began to be noticed about two years ago, but about the middle of 1919 it assumed serious dimensions. A crack in the west end wall opened from footing to roof. In the front wall the joints opened up in zig-zag cracks; the window arches cracked and spalled; the stone lintels broke in two, and the bottom of the wall shoved out about 2½ in. In this condition of progressing failure reconstruction was begun.

So dangerous was the building considered by the contractors that they feared to touch the foundations until the front wall had been anchored as firmly as it could be. On every other floor, at each transverse line of columns, holes were drilled through the walls and steel rods carrying broad outside anchor plates were carried back to bands on the third row of columns and pulled taut. The settlement had been greatest for some 50 ft. about mid-length of the front wall, and therefore reconstruction was begun here. The settle-

ment to be overcome was 0 to 7 in. All six floors of the building were laden with sacks of coffee and chests of tea, the load being estimated to be about 150 lb. a square foot.

Two steel I-beams about 26 ft. long were set parallel on each side of the wall as indicated by Fig. 2. Needle beams resting on the I-beams were inserted through the wall and the I-beams were then blocked and wedged up to a firm bearing. A 6-ft. section of the wall footing was then cut out, the grillage removed, the piles cut off to sound wood below water level and the trapezoidal concrete footing indicated in Fig. 1, was constructed.

When the concrete so placed had set, the space between footing and bottom of wall was filled by three longitudinal rows of screw jacks set so as to touch each other. Then another 6-ft. section was removed and rebuilt, and so on, until the whole of the part affected by settlement had been supported. The column footings were replaced by similar methods, a nest of 24 jacks being put under each column.

When the operations outlined had been repeated until the columns, the front wall and the west end wall (back to the crack) were on jacks, the raising was begun. By simultaneous advances of ¼ in. the jacks were screwed up until the floors and walls were level. During the raising, practically all of the cracks were closed. Finally, the jacks were removed a few at a time and replaced with brick masonry. To insure the new front-wall footing from sliding forward it was anchored back as shown by Fig. 1.

About six months were required for the operation. The contractors were the L. P. Friestedt Co., Chicago, Ill. S. M. Gooder was the superintendent for the contractors.

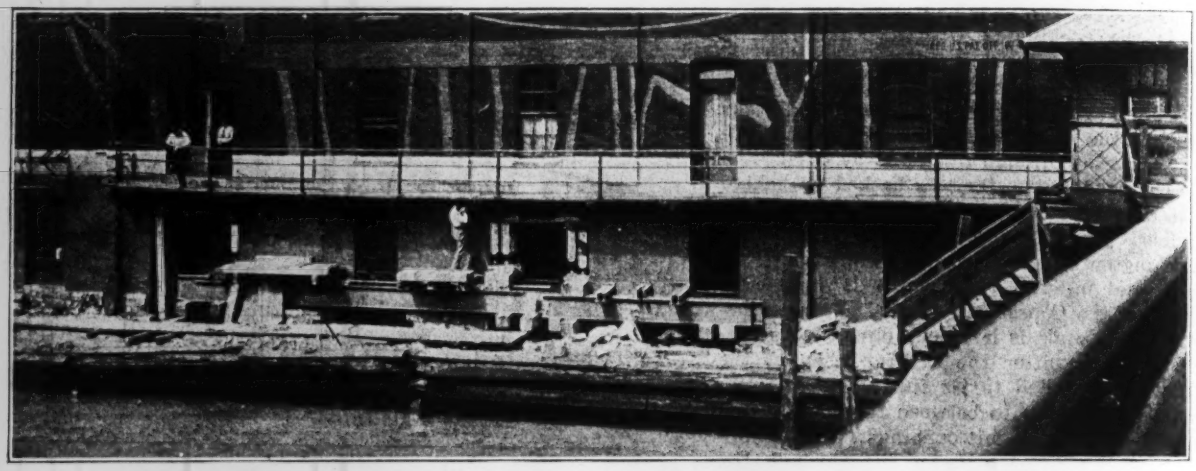


FIG. 2. NEEDLE BEAMS SUPPORT FRONT WALL DURING UNDERPINNING OPERATIONS

Mortar Tamping Reduces Powder Cost

A mortar composed of quick setting cement, plaster of paris and screenings, is advocated for tamping blast holes, by O. P. Chamberlain, general manager, Dolese & Shepard Co., Chicago. The mortar plug is located above the dynamite charge exactly as is the ordinary tamping of screenings or sand. Its use, it is stated, will reduce the amount of dynamite required fully 25 per cent, presumably by making a tighter hole.

Compensation from the Engineer's Point of View

(Extracts from an address by Robert Ridgway, Engineer of Subway Construction, Transit Construction Commission, New York City, delivered April 28 at a meeting of the Municipal Engineers of New York. The general subject under discussion was "Classification and Compensation of Engineers in the Municipal Employ." There were present at the meeting, as guests of the society, the Comptroller and the Civil Service Commissioner.—EDITOR.)

The engineering employee is an educated man. His is work that cannot be picked up by a handy man in a few months' time. He, or someone for him, has spent money and he has given precious time in preparation for his life's work. He is entitled to sufficient compensation to make up to him this time and money spent and to maintain himself and his family not only in decency but in comfort. He should be in a position to educate his children, if he is fortunate enough to have any, and to take part in the affairs of the community in which he resides as a good citizen should do and as educated men in other occupations do.

The engineering employee will not be as good a citizen or give the best service to his employer if he is constantly worried as to where the rent money is to be found and how he is going to obtain needed food, clothes and medicine for those dependent upon him and for whose welfare he is responsible. None of us can do his best work when worried and distracted and with thoughts that are embittered by what seems to be an injustice. When a man has sufficient food, clothes and shelter and a little surplus in addition he can look at things cheerfully but it is hard to be an optimist and to preach contentment when month by month expenses crowd or exceed revenues in spite of the practice of every economy and with no change for the better in sight.

Everyone who has had the direction of men, whether engineers or not, knows the value of cheerfulness and contentment in the force and the demoralization which results from grouchiness and discontent. In one case obstacles which seemed almost insurmountable are overcome with ease and a prodigious amount of work is accomplished through willing team play and co-operation, while in the other case the work drags in spite of everything, errors are made and demoralization follows to the great loss of the employer. The most successful leaders in all enterprises have recognized and profited by these facts and they know that adequate compensation is advisable to assist in maintaining the interest of a good man in the job and to keep him from seeking a better one. We all know that

more can be done with a small efficient force than with a much larger but demoralized one.

Among engineers, as among the laborers, poor pay and discontent mean an excessive turnover on the job, to its detriment. Successful managers of industrial plants frequently speak with pride of the small turnover in their force and claim it makes for efficiency. The same considerations apply with equal weight to engineering service. Good pay keeps good men and poor pay keeps poor men. Good men seek and find better jobs while poor men remain because they cannot obtain better jobs. There are exceptions to all rules, of course, and it sometimes happens that good men remain through a sense of loyalty and interest in a particular job after it ceases to be attractive to them in a pecuniary way. Frequently good men remain so many years in the same public employment that while invaluable for the particular work in which they have specialized they are unfitted by habit and training to undertake new employment and consequently, in the absence of proper recognition, their very loyalty and good service have worked to their positive personal detriment.

I do not wish to be understood as discouraging the idea of a moderate turnover in the force. Changes are necessary for many reasons. It is well to have good men step out from time to time to take up greater responsibilities, thereby giving opportunity to promote and encourage those left behind. Incompetents should be weeded out and shifts made to keep men from growing stale. Any such changes as make for improvement and development should, of course, be encouraged but changes that lead to demoralization are bad.

Figures taken from the records of the New York subway construction work indicate that there was a turnover in the engineering force of practically 450 per cent in the six-year period from 1913 to 1919, during which period the force averaged about 1,040 men; 13 per cent of the force resigned in two months during 1919, most of the reasons given for such action being lack of opportunity and insufficient compensation.

Many have called attention to the part played by our engineers in the recent world war which has been called an engineers' war. Their part would have been even more important had the struggle continued. They have just as important a role to play in the rehabilitation of the world made necessary by the waste of war. The morale of our people has been lowered due to the reaction from the excitement and stress of the struggle. The engineer can lead in the work of restoring this morale if his own morale is not broken. He is as well if not better fitted to carry on the battles of peace as those of the war. Why then is it not the best public policy to encourage him to continue in the work where he is so much needed and for which he has been trained and not drive him through necessity to seek other employment? Is it wise to discourage such men so that they will either seek a future in other lines of human activity, leaving the public work to be done by those less competent to do it, or remain on the job to have their ambition and interest destroyed through a lack of recognition of their service, perhaps entering into unnatural alliances to obtain what they believe to be their due? If we were all doing the work for ourselves or for a private corporation I believe there would be but one answer.

The cost of living has gone up by leaps and bounds since 1914. Common labor on subway work which received $1.60 per day of 8 hours in that year, now gets from $4 to $5 per 8-hour day and the end is not yet. Every class of labor and the material entering into the construction have jumped in price, and the cost of living has mounted to such heights as none of us could have foreseen six years ago. Engineering salaries on public work have not kept pace with these conditions. They have either remained stationary or have been given such slight advances as do not in any way compensate for the increased cost of living.

New York City owes much to its engineers who have planned, constructed and operated the works on which the health, comfort and convenience of the public depend. Generally speaking these utilities function so well that few ever stop to think of the vision of the men whose minds conceived them, of the careful study of each one of the multitude of details making up every structure and of the everyday hard work, carried on amid all sorts of discouragements, which made the plans materialize. Seldom if ever have there been instances of faithlessness on the part of the engineers to the trust reposed in them. The public structures have been well built. Many of them stand as monuments to the constructive genius of the men whose names are forgotten or who were never known to those who today utilize and admire their handiwork.

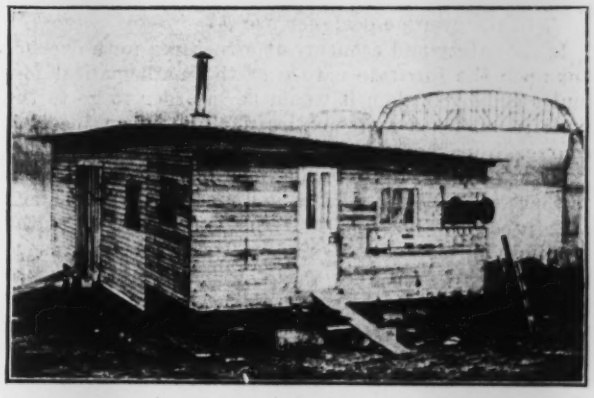
The City urgently needs its engineering staff. Because of its record of accomplishment and of the quantity and quality of the work it has done and is doing for the City the members of this technical staff are certainly entitled to a careful consideration of the merits of any pleas which they may make for relief from their present condition.

Wharf-House for Variable Rivers

By GEORGE W. MCALPIN
Point Pleasant, W. Va.

TEMPORARY storage of freight on rivers with large variations in level presents a number of difficulties. The problem has been satisfactorily solved at Point Pleasant, W. Va., on the Ohio River, by the use of the movable wharf-house shown in the accompanying view.

This building is nothing more than an ordinary shed, built on a frame resting upon wheels and made to suit



FREIGHT WAREHOUSE MOVED UP AND DOWN BANK

the slope of the public wharf. By means of a ½-in. wire line, leading to a small winch at top of bank, the wharf-house may be brought up the bank as the stage of river requires. It descends the slope by gravity.

The wharf-house is carried on a frame of 6 x 8-in. timbers and fitted with four wheels, 2 in. in diameter and 8 in. tread. The house proper is about 16 x 26 ft. A 6-ft. extension, at one end, provides an office for the clerk. Large double doors are provided at one side for the entrance and exit of freight. Being on wheels, the shed can always be placed near the water's edge and thus facilitates handling of freight. It may be pulled up the bank during high water and again lowered as the water recedes. Small chocks are used, under the front wheels, as an additional safeguard to prevent the house moving. Telephone connections, as may be seen from the view, are provided on a reel attached to the house.

Ed. Varian, of Point Pleasant, W. Va., has found the idea, which he originated, to work out successfully in practice.

A Call for A Practical View In Structural Teaching

By Edward Godfrey
Structural Engineer, Pittsburgh, Pa.

THIS article is not intended to discredit proper theory, theory based on fact, but it is a plea in the interest of average designers and in the interest of safe design for simplification of theory in connection with problems of design. It is easy for a college professor or a man who thinks in integral signs to work up a nice theory for keeping stresses within prescribed limits, but here are some questions that every theoretical investigator should ask himself and should answer satisfactorily:

Queries: 1. Is my theory based on fact? 2. Does it take account of all the facts that may have a measurable influence in the results? 3. Are the properties assumed for the materials considered actually the properties of those materials, or are they just ideal assumptions as to the properties? 4. Is there any way to simplify the formulas in their application to practical design, or is there some simpler way to arrive at equivalent results? 5. Are there practical considerations which, in fabrication of the structure or in its handling, may vitiate the assumptions? 6. Does the formula or method presuppose workmanship that is of unattainable perfection or not commercially possible or usual? 7. Will the average designer use it?

If the safety and economy of structures were dependent upon the intricate nature of the mathematical formulas employed, then it would be in order to go to the limit in abstruse mathematics during the engineering course. But the end and aim of instruction in structural engineering is to enable men to design structures that are safe and economical, and manifestly the method that produces this result in the simplest way is the best possible method. A simple method is better grasped by the average designer and is less liable to give rise to errors. If it can be shown that a theory is based on false premises as to the nature of the materials, and, further, that introduction of that theory decreases the chances of safe design because of the difficulty of applying it, a strong case is made out for substituting simplified for complex theory.

There can be no conflict between theory and practice, if the theory is right and is based on fact. There is just as much theory in practice as there is in what is termed theory. Horse sense is simply the fag ends of theory that do not admit of nice theoretic treatment by formulas. It is when theory goes beyond the province of premises based on fact that it begins to be useless and a cumbersome burden in our engineering literature and college courses.

Retaining Wall Theories—Retaining wall theories as given in our textbooks are very complex. They are based on the assumption of properties that no earth possesses. The things that work against a retaining wall are frost and wedges of wet, lubricated earth. If the earth be assumed to be a liquid of a weight per cubic foot a fraction of its actual weight, the designing of retaining walls and bins can be greatly simplified; and stability as well as economic design can be arrived at by this simple method as well as by the most complex theory.

Elastic Arches in Masonry—The elastic-arch theory in masonry is purely theoretical, with a slender basis in fact. The old row-of-blocks method is more reliable. It is good practice to design by this method for hinged ends, and then anchor the ends into the abutment as part of the factor of safety. Over in Europe they were so anxious to meet all the conditions of the theory that they made polished and greased hinges for a masonry arch; the arch collapsed.

Assumption of horizontal pressure against the haunches of an arch and reliance upon the same in design has also little to warrant it in fact.

Truss Pins—Many years ago it was discovered that truss pins did not fail when their theoretic stress exceeded the ultimate strength of the steel. The toughness of the steel allowed adjustment in the stresses. Engineers wisely allowed unit stresses no higher than would be safe, if they actually were realized. There are other examples where steel will adjust itself to theoretically adverse conditions and give permanent stability.

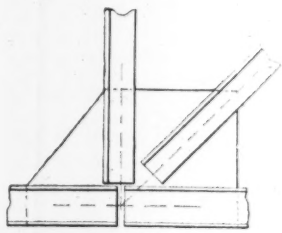


FIG. 1. GUSSET USED AS CORD SPLICE

Secondary Stresses and Least Work—It is surprising to find how few engineers engaged in designing know anything about secondary stresses, relative rigidities or least work. Still fewer make any use of them. Once in a while a designer wastes a lot of time figuring the secondary stresses due to the deflection of a truss. There may be designers who make allowance for the deflection of a girder rigidly attached to a column (the proper detail) and proportion the column or bridge post for the bending moment, but I have never had a design of that sort to check.

Do theorists ever stop to consider that the milling of a girder $\frac{1}{16}$ or $\frac{1}{8}$ in. out of true on the end may give rise to theoretical stresses just as great as those due to the deflection of the girder, and that the inaccuracy may be in a direction that would double the stress due to deflection? It is a simple matter to show that commercial shop work gives rise to paper stresses that would wreck many a structure. But the structures stand up, and there is no record of a single failure from these textbook stresses. In my judgment, structures that have the most stresses of this kind are the safest, for example the Firth of Forth bridge.

The things to be feared and most carefully guarded against in structural steelwork are buckling failure and excessive deflection. It is vastly more important to guard against these, even at the cost of some little increase in unit stress, than to take such care of theoretical unit stresses. Rigid connections lessen deflection and forestall buckling, hence these are excellent, in spite of the fact that they give rise to secondary stresses. The only high beam-and-column building that ever collapsed was one having cast-iron columns. The *lack* of rigid connections, this bugbear of the theorist, is the thing that brought down the building.

If the space given over to discussion of least work were taken up with emphasis of the importance of proper bracing of compression members and the upper flanges of beams and girders, proper details, questions of bracing and stability in general, and the glaring faults in

lesign, the work turned out by designers would be greatly improved.

I have heard an eminent engineer say that girder webs should be spliced for bending as well as shear, because the web plate is subject to the same extension and shortening, at the bottom and top edges, as the flanges. What could happen, if a web plate is spliced only for shear, say with a single row of rivets on each side of the cut? Suppose the extreme rivets should slip an insignificant trifle; this would not impair their value for taking shear one iota, and, with flanges proportioned for the full flange stress there is absolutely no weakness of any kind in the girder. There are many cases where, if the fact is recognized that steel is tough as well as elastic, it will be seen that unit stresses may be increased a little without introducing any real menace to the structure; the theoretical treatment of our textbooks fail to recognize this. It is not by any means true that wherever there are adverse conditions connecting high unit stresses in the steel the structure will adjust itself to those conditions. It will do so only where the toughness of the metal comes into play and reduces the real unit stress or forestalls any increase of deflection beyond a small amount.

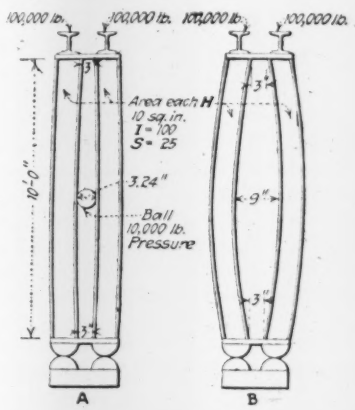


FIG. 2. TWO DOUBLE COLUMNS OF UNEQUAL SAFETY

Fig. 1 shows a gusset plate used as a splice. Some designers will take this whole plate as available as though it were symmetrical, which is plainly an error. Theoretically a plate wider than the channels will have an extreme-fiber stress greater than a symmetrical plate just the width of the channels. Why not use the portion of the plate covered by the channels as available for splices? For, the part of the gusset plate above the channel does not render the splice any less safe—not in a tough metal like steel.

Two pairs of twin columns are sketched in Fig. 2. In the pair at A, straight columns are wedged apart 0.24 in. and held with a ball (so as not to brace the flanges). In the pair at B the H-sections are bowed. The bending moment in the first pair is 300,000 in.-lb. due to the pressure on the ball. The bending moment in the second pair is 300,000 in.-lb. due to the bow. Theoretically, then, the pairs of columns are identically stressed. Actually, if they were made of a hypothetical metal such as the theorist deals with, the nearest thing to which is glass, they would be equally dangerous. I venture to say that there is not an engineer living who will assert that the columns at A are anywhere near as unsafe as those at B. What becomes of our theory, then?

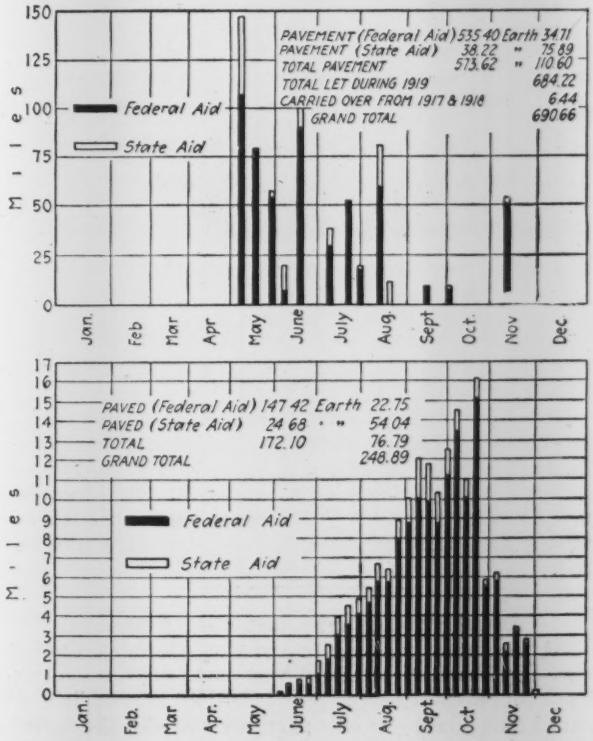
Mill-building designing can be and has been made very complex, so much so that designers ignore completely the textbook treatment, with the result that designs are generally bad. Mill-building design can be made quite simple, if relative rigidity and least work be put to sleep. The method is simply to take advantage of the full available bending strength of the columns (to resist wind moments) at the base and at the foot of knee braces, regardless of whether the angles of inclination of the column axes at the points of inflection are identical or not. If textbooks would show this simple method, it would doubtless improve mill-building design, because it would put the subject within reach of the average designer.

Road Construction in Illinois During 1919

By B. H. Piepmeir

Engineer of Construction, State of Illinois, Department of Public Works and Buildings, Division of Highways

During 1919 there were 685.39 miles of Federal-aid and state-aid roads placed under contract. In addition there were 6.44 miles of roads carried over from 1917 and 1918, making a total of 691.83 miles placed under construction in 1919. There were completed during 1919, 247.24 miles, or 36 per cent of all work. The accompanying chart clearly shows when the work was placed under contract and the construction progress. A careful study of the chart shows that a great many more miles could have been completed had the work been placed under contract at an earlier date. There were several other outstanding causes that delayed the work. It will be noted that the maximum mileage per week was not reached until the month of October, a condition attributable to the inability of contractors to secure road equipment. Many contractors were delayed from three to four months in getting proper machinery, and delays due to machinery repairs



TOP—CONTRACTS LET AND TOTAL MILEAGE.
BOTTOM—WEEKLY PROGRESS, 1919

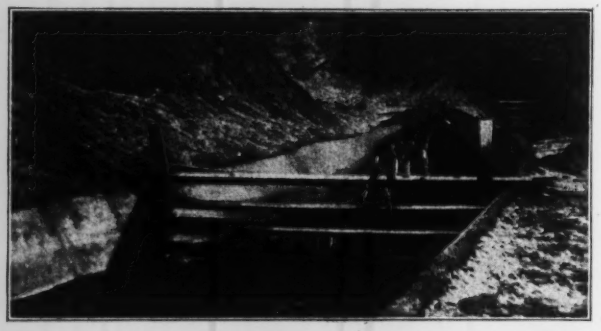
were also very serious. Another serious cause for delay was shortage of material, much of the equipment working but half the time on account of such a shortage. Then labor shortage and labor strikes in various divisions of work seriously delayed the delivery of materials and the progress of the work. About the time that the maximum amount of work per week was reached it was suddenly stopped by winter weather. Had the construction season been two months longer fully 100 per cent more work could have been finished.

The slow progress of the work in 1919 could in no way be charged against the contractors. In general they exerted every possible effort and in many instances the contractors who tried to produce the greatest mileage got the least results.

On account of the unfavorable conditions existing during 1919 the contractor who organized and planned to do a large volume of work produced much less in proportion to his investment and effort than the one who operated the smaller unit. It was almost impossible to work the larger units to their capacity on account of the shortage of labor and material. The smaller units were worked to their capacity a very large part of their time, hence proved to be more economical. However, the larger units have their many advantages and under normal conditions prove their economy.

Deer Ladders a Necessity in Flume

The three miles of concrete-lined flume which brings water to the Cherry Creek power house on the Hetch Hetchy Project, lies in a territory abounding in deer.



HOW DEER USE LADDERS BUILT ESPECIALLY FOR THEM

When water was first turned into the flume there was a good deal of trouble with deer which got into it and could not get out unaided. As many as 30 to 40 deer have been taken out of the flume in a single month.

To relieve this condition, deer ladders made of planks, as shown in the accompanying illustration, were built in the flume line at intervals. The ladders extend below the water as well as above so that the deer can find a footing on which to climb out. Since the ladders were put in there has been no further trouble with the deer.

Aerial Photography and City Planning

At the recent meeting of the City Planning Conference at Cincinnati provision was made for the appointment of committees to consider the adaptability of aerial photography to city planning and also the usefulness of moving pictures in city planning propaganda, these committees to report to the next conference.

Suitable Areas for Regional Plans

Condensed from a Brief Submitted to a Committee of the City Planning Institute by Thomas Adams, Town Planning Adviser, Canadian Commission of Conservation, Ottawa, Ont.

IN DETERMINING what a region should be for purposes of planning, we should have in mind the limited area which it is practical for any man or group of men properly to plan in one operation. Moreover, we should have in view what is the dominating feature which makes the area appropriate as a unit for planning. An arbitrary city boundary is not a satisfactory planning unit unles sit be in the case of a city that is practically stationary in development. I think the groups of regions and order of planning to have in mind are: (1) An industrial area having problems and conditions in common and comprising incorporated areas, or parts of incorporated areas, adjacent to one to one another; (2) An agricultural region round a market town or village, where the problems of town and country are so intermingled as to require treatment in one comprehensive scheme; (3) A mining region, consisting of a series of villages in a large coal bearing or other area where the industry dominates the whole development; (4) A metropolitian region where a large city has thrown out a number of satellite towns or suburban districts or has overgrown its boundaries.

As a tentative scheme the following may be considered as the order in which planning should be done: (a) Regional survey of social, industrial, and other conditions; (b) a regional plan, showing tentative proposals for main highways, extensions of highways, general position of districts for industry and residence giving some indication of height and use of buildings, etc.; (c) a definite city or town plan, going into detailed development subject to general conformity with the regional plan.

Where necessary, the city plan might be preceded by a further survey to be called the "civic survey" as supplementary to the regional survey, but dealing only with the incorporated area.

The objective should be to adapt the area to the planning rather than to attempt to adapt a plan to an unintelligible boundary of an incorporated area. By these means we shall simply be adopting the British and German idea that we should plan the environments of a city at the same time that we attempt to deal with the improvement of the existing city. The German plans deal with town extension rather than with town reconstruction. The British plans deal primarily with areas unbuilt upon. American city planning and zoning schemes have been too much confined to areas already developed and should broaden out to deal both with developed areas and with undeveloped areas including those that grow out from one common centre and are likely to undergo development in the future. Modern transportation and methods of power distribution are forcing us to adopt new geographical areas for planning.

The suggestion is that this regional scheme should merely be a tentative one as the basis for the civic plans to be prepared for each administrative unit within the region. It is also the proper area for carrying on research and surveys of conditions.

New Chicago Double-Deck Bascule Highway Bridge

A NEW double-leaf double-deck highway trunnion bascule bridge of 256-ft. span and 6,700 tons weight, scheduled to be put in service on May 14, over the Chicago River at Michigan Ave., is the main feature in the widening and extension of Michigan Ave. to connect the boulevard systems north and south of the river.

The bridge is of the trunnion type developed for the city's bridges in 1898 by the engineering bureau of the Department of Public Works, under John Ericson as city

SOUTH LEAF OF DOUBLE-DECK BASCULE BRIDGE AT CHICAGO

engineer. It has four lines of trusses, forming practically two separate bridges, the inner trusses being connected by bolted diaphragms which can be disconnected if necessary, as in case of damage to one part of the bridge by a vessel. The lower deck is for trucks and wagons and the upper deck for automobiles and pleasure traffic, the latter reaching the upper elevation by inclined viaduct approaches. On the upper deck are two 27-ft. roadways with 15-ft. sidewalks on cantilever brackets, making a total width of 91 ft. 9 in. On the lower deck are two 18-ft. roadways and 6-ft. sidewalks, all between the trusses.

Each leaf weighs 3,350 tons, with 1,595 tons of counterweight, and is operated by pinions gearing with concave racks in the heels of the outer trusses. For each leaf there are four electric motors of 100 hp., two being for reserve. A description of the substructure, with deep foundation piers carrying concrete boxes for the tail pits, was given in *Engineering News-Record*, Dec. 25, 1919, p. 1056. Another double-deck trunnion bascule bridge of the same type, but of 245-ft. span, carries Lake St. and the elevated railway across the Chicago River. In span, but not in weight, the Michigan Ave. bridge is surpassed by two other bascules of different types: the 336-ft., 3,750-ton Strauss trunnion bascule of the Canadian Pacific Ry. over the ship canal at Sault Ste. Marie, Mich., and the 310-ft., 4,500-ton Scherzer rolling-lift bascule over the Tennessee River at Market St., Chattanooga, Tenn.

Plans for the Michigan Ave. bridge were prepared in the city's bureau of engineering under the direction of Hugh E. Young, engineer of bridge design; Thomas G. Pihlfeldt, engineer of bridges; P. S. Combs, city engineer, and C. D. Hill, chief engineer of the Board of Local Improvements. William A. Mulcahy was chief engineer in charge of construction. The general contract was taken by the Great Lakes Dredge & Dock Co., which did the substructure work and steel erection, the steel being fabricated by the American Bridge Co. Erection was commenced Sept. 22, 1919, and completed Jan. 15, 1920.

Building Trades Receive Flat Increase of One Dollar Per Day

Acting upon a request from the Building Trades Council, New York City, for an increase in wages for all trades, the Executive Committee of the Board of Governors of the Building Trades Employers' Association has granted a flat increase, effective May 1 of $1 per day. Thereby modifying the wage scale fixed November 20, 1919. The new scale and the trades affected are given herewith:

	Per Day, Eight Hr.
Art Glass Workers	$8.00
Asbestos Workers and Insulators	9.00
Blue Stone Cutters	9.00
Carpenters	9.00
Dockbuilders, House Shorers and Sheathpilers	9.00
Cement and Concrete Workers (Laborers)	6.50
Composition Roofers and Waterproofers	8.00
Composition Roofers and Waterproofers (Foremen)	8.50
Electrical Workers	9.00
Electrical Workers' Helpers	5.50
Elevator Constructors	9.00
Elevator Constructors' Helpers	7.00
Hoisting Engineers, by the Week	52.25
Hoisting Engineers, by the Day	10.00
Hoisting Engineers, Running Compressors, extra per Week	7.00
Housesmiths and Bridgemen, Local No. 40	9.00
Housesmiths' Finishers, Local No. 52	9.00
Housesmiths' Helpers	7.00
Marble Cutters and Setters	9.00
Marble Carvers	10.00
Marble Polishers, Bed Rubbers and Sawyers	8.50
Marble Cutters' Helpers, Riggers, Crane and Derrick men	7.00
Mosaic and Terrazzo Workers	8.00
Mosaic and Terrazzo Workers' Helpers	6.50
Metallic Lathers	9.00
Plasterers	9.50
Plasterers' Laborers	7.00
Plumbers and Gasfitters	9.00
Roofers and Sheet Metal Workers	9.00
Riggers and Machinery Movers	9.00
Steam and Hot Water Fitters	9.00
Steam and Hot Water Fitters' Helpers	7.00
Stone Derrickmen	8.00
Tile Layers	9.00
Tile Layers' Helpers	7.00
Wood Lathers	9.00

Alaska Lignite Compares Favorably With That of North Dakota

Steaming tests on the relative value of Alaska lignite and spruce carried out by the Alaska station of the Bureau of Mines indicate substantially the same behavior as that of North Dakota lignite. From 3 to 4 lb. of water were evaporated in a 125-hp. water tube boiler with lignite obtained near the surface and therefore not considered of the highest quality available. The spruce evaporated 3.7 lb. After 14 months the loss of weight due to weathering of the lignite was 6.1 per cent.

Difficulties of Winter Work on Alaska Railway

A TEMPERATURE range of from —70 deg. F. in winter to +100 deg. F. in the shade in summer, combined with a precipitation of 40 to 80 in. in the rainy district, are conditions in Alaska which accentuate the difficulties of railway construction and maintenance, as outlined by F. A. Hansen, engineer of construction and maintenance of the Alaskan Engineering Commission, in the *Alaska Railroad Record*. Survey work and distribution of supplies must be done during the winter in preparation for the short construction season of June to September. Distribution in winter has the advantage that transportation of materials on selds over the ice is easier and cheaper than building corduroy roads over soft ground in the warmer months.

The engineers' work in winter includes running surveys in deep snow, climbing slippery hills for cross-section work and digging through several feet of snow to ascertain soil and surface conditions. Camp construction for stationmen and supply points seems almost impossible with timbers frozen solid and everything deep in snow and ice. Keeping warm under canvas with the thermometer low is a difficult proposition. But it is necessary for the engineers to be active during the winter in order to get the main camps established and material, supplies and contractors' equipment distributed along the line.

Extraordinary difficulties have been met this year, says Mr. Hansen. For the advance from Indian River, which is at the head of navigation on the Susitna River, it was necessary to transport supplies into the Broad Pass Country over snow which since Jan. 1 has averaged at least 10 ft. in depth. From Talkeetna to the Broad Pass summit about 5 or 6 ft. of snow will fall in a single storm. All trails are obliterated and must be remade despite the fact that teams are constantly on the trail. For long distances the trail is on the river. A sudden thaw and the trail is gone. Several times teamsters have had narrow escapes as sled and cargo sank beneath the softened ice. When starting with a load from the end of the track, with a warm chinook blowing, the thermometer may be above freezing point, but by nightfall it may fall to 40 deg. below zero. From Mile 240 supplies are transported over trails to Hurricane Gulch, Mile 284, which is the objective point for the construction work in the coming season, as outlined in *Engineering News-Record*, April 29, 1920, page 850.

From its southern terminal at Seward the railway passes for 90 miles through a district that experiences many climatic extremes but not the lowest temperatures. The line is flanked by glaciers and rugged mountain sides that are saturated by heavy rainfall and are alternately frozen by the north wind and thawed by the breezes of the Japan current blowing through Portage Pass. Then the line is confronted by the tremendous tides of Turnagain Arm, where in the winter a sea of ice moves at the rate of 10 mi. per hour, tearing at the rock-protected slopes of the fills and threatening to lift the trestles from their foundations. This latter trouble has been overcome by filling in around the piling with heavy rock. Under the influence of a warm chinook wind the snow starts to melt on slopes that reach back into the mountains for a mile or two, and then come the slides. Since snowslides cannot be stopped, it is necessary to build snowsheds where the slides usually cross the railway.

Sudden temperature rise and rainfall in January may result in filling the space between the rails with water, which a sudden drop in temperature will turn into a sheet of ice covering the rails. To avoid this trouble, the weather conditions are watched and trains are operated continuously over the threatened stretch of track, using the flanger to throw out the water as it accumulates.

Reinforcement of Manholes in Tanks

MOST steel structures are designed to carry stresses due to assumed loads, which exceed anything they will ever have to carry in actual practice, but a steel tank when filled is subject to the full stress for which it is designed, and therefore has no factor of safety above that shown by a calculation of the stresses. It is quite customary in designing large tanks to use from 16,000 to 20,000 lb. per sq.in. as the allowable unit stress in tension in the plates, and the tank is then said to have a factor of safety of 3 to 3½, because the ultimate strength of the plates is that many times the stress to which they are subjected. The actual factor of safety is really much less than the above figures, as the elastic limit of steel is not much more than one-half the ultimate strength, and if steel is stressed up to the elastic limit it cannot properly be said to have any factor of safety.

Large tanks are now usually built with double butt joints in the lower rings of heavy plates, and these joints, if correctly designed, have an efficiency of approximately 90 per cent. It is safe to say that the weakest point in large tanks as they are generally built today is not at the joints in the plates but at the manhole, which is almost invariably located in the lowest ring near the bottom, at the point of greatest stress. These manholes are usually 20 in. in diameter and built in the form of a flanged steel nozzle with a steel plate cover bolted on.

It seems like wasted effort to build a tank having rings 5 ft. wide with butt joints having 90 per cent efficiency to splice the plates, and to then cut a 20-in. manhole in the center of the plate, taking out one-third of the metal and reducing the efficiency at that point to 66⅔ per cent. It is true that the manhole nozzle reinforces the opening to a certain extent, but as it is usually made of a light steel plate, rolled into a circle and sometimes riveted, sometimes welded together, the amount by which it reinforces the opening is not enough to compensate for the metal cut out. The obvious remedy is to put a reinforcing plate around the manhole opening having as much section as the manhole cut out, and attaching it to the shell plate with enough rivets to develop its full strength.

It is a certain fact that there are many large tanks in use today which have a very small factor of safety at the manhole opening. Occasionally, as at Boston, one will fail, and the attention of buyers will again be forcibly called to the old adage that no chain is stronger than its weakest link, and that a mere statement of the plate thicknesses of which a tank is to be built is no indication of the real value of the structure.—From *The Water Tower*, Chicago Bridge & Iron Works.

Concrete and Stone Bridges Show Low Maintenance Cost

Repairs Negligible in Pittsburgh's Experience With Concrete Arches for Ten Years and Stone Arches for Twenty Years

EXCELLENT maintenance records are being made by large reinforced-concrete arch bridges in Pittsburgh. The earliest of these is the Meadow St. bridge built in 1910, which has a central span of 209 ft. Two years later the 300-ft. Larimer Ave. arch was constructed, and in the same year or the following year several others were built, of spans up to 168 ft. All these structures are today in excellent condition; none of them calls for any expenditure to improve its structural or æsthetic condition, according to John D. Stevenson, bridge engineer of the city's Department of Public Works. While the surface of the concrete has been darkened and soiled by locomotive blast where the bridges are over railroads, and thereby the effect of special color and texture has been lost, cleaning is not considered worth while.

From the department's cost records the following figures for maintenance and repair expenditures to date have been obtained:

Meadow St. arch, 1910 (209-ft. span, cost $72,353); total expenditure $598, covering three repaintings of the metal handrail.

Larimer Ave. arch, 1912 (300 ft. 4¼-in. span, cost $168,109); total expenditure $1289. Besides handrail painting, this includes draining and cleaning one of the abutments, whose interior had filled with water from a pipe leak (1914), and minor repairs to footwalk and rail (1916).

Atherton Ave. bridges, 1912 (three 90-ft. arches over Pennsylvania R. R., $93,128; one 168½-ft. arch over Pittsburgh Junction R. R., with 41½ and 56-ft. flanking spans, $91,000); no expenditure whatever and none now needed.

Hoeveler St. arch, 1912 (total length 163 ft. 6 in., reinforced-concrete arch with filled spandrels, span 60 ft. 8¾ in., cost $28,765.81); total expenditure $32.76, all on lamp posts.

Murray Ave. arch, 1913 (total length 375 ft., reinforced-concrete arch rib of 210-ft. span, 66-ft. clearance height, cost $97,895.76); total expenditure $935.61, all on railing and lamp posts.

Heth's Run arch, 1915 (total length 327 ft., clearance height 68 ft. 9 in., reinforced-concrete arch with filled spandrels, clear span 195 ft., cost $136,066.57); total maintenance expenditure $298.40, all of which was on lamp posts.

Stone-arch bridges show equally good records, and experience with them extends over a longer period of time. On the face of the returns they have in fact given better service, but some modifying factors need to be taken into account. Neither light posts nor paving on these particular structures is maintained by the Department of Public Works, and therefore the corresponding maintenance expenditures do not appear in the records. The paving on the Stanton Ave. and Schenley Park stone arches (mentioned below) is maintained by the Bureau of Parks, while the Lincoln Ave. stone arch was at one time repaved by the Division of Streets in connection with adjacent street repaving.

Furthermore, all of the stone arches have stone parapets, while most of the concrete bridges have metal railings. These latter are damaged rather frequently by collisions, and also require repainting. When these facts are considered, Mr. Stevenson states, it is doubtful that the stone arches really have a lower maintenance cost than the concrete arches. The following data, however, are quoted from the records of the Department of Public Works:

A 50-ft. stone arch on Hill Road, built in 1895; a 60-ft. stone arch on Stanton Ave., built in 1896; and a 150-ft. stone arch at the entrance to Schenley Park, built in 1898, have had no money spent upon them for repair or maintenance, exclusive of paving. In the case of the Lincoln Ave. bridge over Washington Boulevard, comprising two 130-ft. stone arches, built in 1905, the sum of $9 was spent for repainting the handrail. This bridge, however, was once repaved.

The Stanton Ave. arch, which is of filled spandrel construction, may require some expenditure for repairs in the future. The spandrel wall on one side has pushed out, presumably from the pressure of the fill, so that it overhangs the arch ring about 1 in. As there has been no movement here during the past five years, immediate repair is not considered necessary.

Maintenance of the city's numerous steel bridges varies widely, depending on local conditions such as low clearance over railroad tracks, and paving maintained by the street railway company. Renewal of wood flooring and sidewalks also contributes to the maintenance cost. A particularly good record was made by the Schenley Park bridge over the Pittsburgh Junction R. R., a 360-ft. steel arch with crown height of about 100 ft. above the track. This structure, built in 1896, has required an expenditure of only $12,800 for maintenance and repair work, exclusive of paving, practically all of which represents repainting. This is less than $600 per year, representing 4% interest on $15,000. The bridge, however, needs repainting badly and in another year will need a new handrail. Another good record is that of the Forbes St. bridge over the Pittsburgh Junction R. R., built in 1898. It is a structure 255½ ft. long, and contains a three-hinged steel arch of 144-ft. span. It cost $53,344, and the maintenance cost (largely for painting) amounts to $5,125.65.

The Beechwood Boulevard bridge over Forward Ave., a wooden structure 555 ft. long, built in 1909, exemplifies very high maintenance costs. The bridge had a clearance height of 125 ft., and comprises three 15-ft. wood beam spans and 12 wood Fink truss spans (seven of 30 ft., one of 45 ft., three of 60 ft., and one of 75 ft.). Its original cost was $24,922. Though only 10 years old, it has cost $13,526.97 to maintain, of which sum $4,228.38 was spent in 1918. It is in very bad condition at present, and will have to be replaced. A concrete arch bridge is under consideration for this place.

How Much Alkali Can Crops Tolerate?

The alkali content which crops will tolerate regularly varies from 500 p.p.m. with sodium carbonate to 5,000 p.p.m. of sodium sulphate. For sodium chloride it is 1,000 p.p.m. and a content of 4,000 p.p.m. of mixed salts is dangerous. Much stronger solutions may be applied in single irrigations or for only one year according to a bulletin of the Utah Agricultural Experiment station.

Progress of the Major Street Plan in St. Louis

Avenue Widened for One Mile To Give Continuous Five-Mile Thoroughfare Between Business and Residential District at Cost of $550,000—Benefit Taxing District—Widening Street to 100 Feet for Distance of 6½ Miles To Cost $2,250,000

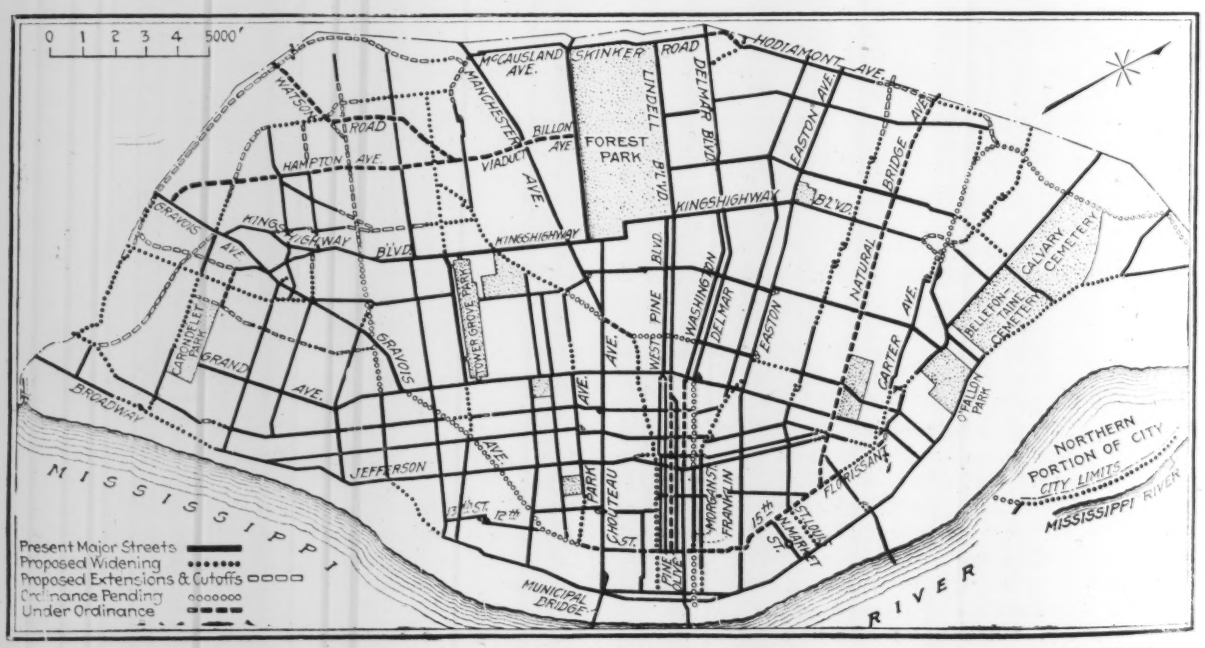
By Harland Bartholomew
Engineer, City Plan Commission, St. Louis

THE major street plan for St. Louis, Mo., prepared by the City Plan Commisssion early in 1917, and described at length in *Engineering News-Record*, July 19, 1917, p. 100, has received the approval of the Board of Public Service and substantial progress has since been made. Ordinances have been passed and legal proceedings for land taking are in various stages of progress for the majority of the more important and most expensive projects under the plan.

The most important project now nearing completion is the widening of Washington Ave. from 60 to 80 ft. between Jefferson and Grand Avenues, for a distance of 5,479 ft. This will create the first direct and continuous street approach to the business district having a width of over 60 ft. West of Grand Ave., Washington Ave. now has a width of 70 ft. The improvement will create a direct continuous thoroughfare five miles long between the business district and the most active residential district, precisely in the line of heaviest traffic movement. Its total cost is $552,512, of which the city's share is $66,715. The widening is accomplished by taking 10 ft. from properties on either side of the street—many properties having a 10- to 15-ft. setback from the present street line. By passing an amendatory ordinance to the original bill permitting encroachments of not over 3 ft. to remain, a substantial saving in damages to improvements was effected and the total cost of the improvement materially reduced. Washington Ave. has an offset at Grand Ave., the city's busiest crosstown thoroughfare, which has already been remedied previous to the completion of the entire street widening plan.

Two interesting and important precedents were established with this improvement; one, the fixing of the benefit taxing district, and the other, a very commendable co-operative effort between several public organizations, city authorities and property owners whereby threatened legal proceedings were averted and a further possible delay of two or three years avoided. The benefit taxing district was confined entirely to property fronting on Washington Ave. throughout its length of six miles. This is the first time a benefit district failed to include one or more parallel streets. Its establishment was perfectly logical, however, since the actual benefit which will accrue to property as a result of the opening is increased value for commercial or apartment house purposes resulting from probable increased traffic—Washington Ave. being destined to become one of the city's leading business thoroughfares. When the street is first opened it will attract traffic from other parallel streets and hence its result on those streets will be in no wise a direct benefit to them; and in fact would really be detrimental, were it not for the fact that traffic is increasing so rapidly that there will be a sufficient amount to sustain realty values on other parallel routes.

When the report of the commission to fix benefits and damages was filed, exceptions to the findings of the commission were taken by owners of four different properties. For the court to review the work of the com-



RELATION OF PRESENT STREET OPENINGS AND WIDENINGS TO THE MAJOR STREET PLAN OF ST. LOUIS

mission, with possible appeal from its decision to higher courts, would undoubtedly have consumed two or three years' time, if not considerably longer. Since the number of exceptions taken were so few in number and in value as compared with the many hundreds of properties involved, a committee of citizens and of representatives of public organizations prevailed upon the objectors to withdraw their suits and the work was permitted to continue to immediate completion.

From the north and from the south sections of St. Louis there now exists no satisfactory, continuous wide street connection to the business district. To remedy this situation an ordinance was passed in April, 1918, providing for the extension of 12th St. directly south, 80 ft. wide, from the southern end of the 12th St. viaduct to Park Ave., from which street 12th again continues southwardly having a width of 80 ft. This improvement will cost $246,000. The city's share was fixed by the commission as only $6,000. Northwardly

CUT-OFF RECENTLY COMPLETED AT WASHINGTON AND GRAND AVENUES

from the viaduct to Market St., a width of 150 ft. is proposed (a distance of 1,152 ft.) to correspond with the present width of 12th St. between Market St. and Washington Ave. The ordinance for this widening was passed Feb. 14, 1919.

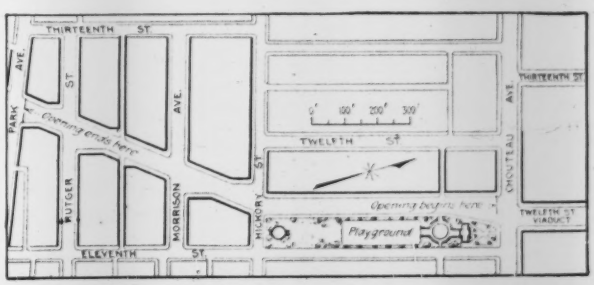
To the north, 12th St. is the principal approach from the business district, though its present inadequate width must of necessity be increased. This will be a more difficult and expensive improvement than any now under way. It will be approximately two miles long, have a width of 100 ft., and afford an outlet for at least four important radial thoroughfares. Its cost will be about $1,500,000, of which the city's share is estimated at $450,000. The proposed street follows the lines of what are now called High St. and 15th St. It traverses largely the foreign quarter, will destroy no particularly good buildings and consequently is a comparatively cheap undertaking when compared with its great length. This street will form the logical route for any future rapid transit line to the north and northwest. It will be of immense value to a great portion of the north and northwest sections, thus permitting a large benefit assessment district with no particularly burdensome local assessments. The ordinance for this project was passed Feb. 24, 1920.

The Board of Public Service recently authorized the preparation and introduction of two other ordinances

LOOKING WEST ON WASHINGTON AVENUE, EAST OF GRAND AVENUE, IN 1918

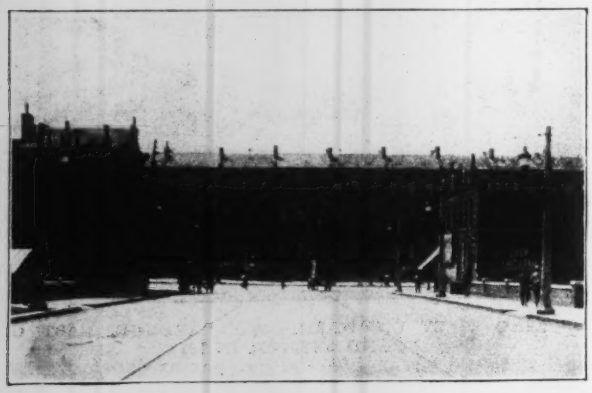
which will complete the 12th St. development in the northern and southern parts of the city. The first provides for the widening of Palm St. and Natural Bridge Ave. from 60 to 100 ft., beginning at the terminus of the North 12th St. opening and extending to the city limits, a distance of 4½ miles, traversing much undeveloped property in the western part of the city. This project is estimated to cost $750,000. The ordinance for it was passed in April, 1920. The second project is for the widening of Gravois Ave. and 12th St. to 100 ft. southwestward from Hickory St. to Grand Ave., a distance of 2½ miles. This project is estimated to cost $1,250,000 and involves the destruction of a considerable number of buildings, but most of these buildings are old structures of small value.

The most important of all the major street plan projects has been the widening of Olive St. between 12th St. and Channing Ave., a distance of approximately two miles. Olive St. is 60 ft. wide and has a 36-ft. roadway, occupied by the most used transit line in the city. Olive St. was formerly one of the important business streets of the city but for several years property has depreciated in value because of its inadequate width and inaccessibility for traffic purposes. Numerous suggestions for rehabilitation of the street have been made for several years, but nothing done. In co-operation with owners and agents a plan was prepared for cutting off 40 ft. from the front of the lots on the south side in order to create a 100-ft thoroughfare. This plan was arrived at only after consideration of numerous other plans, such as widening on both sides of the street or by taking all of the property on the south side of the street to the alley. The lot depths on either side of Olive St. average about 109 ft. There are several large buildings on the north side of the street, to condemn which would cost a considerable sum of money. It was found that by far the cheaper plan



SOUTH TWELFTH STREET EXTENSION AND VIADUCT APPROACH

Now being completed. Distance 1,520 ft. Width 80 to 210 ft. Cost $246,000.



ABRUPT ENDING AT CHOUTEAU AVENUE OF TWELFTH STREET VIADUCT OVER MILL CREEK VALLEY

The buildings that here block the way have recently been torn down and a direct connection between the viaduct and Twelfth St. south of Park Ave. is being made.

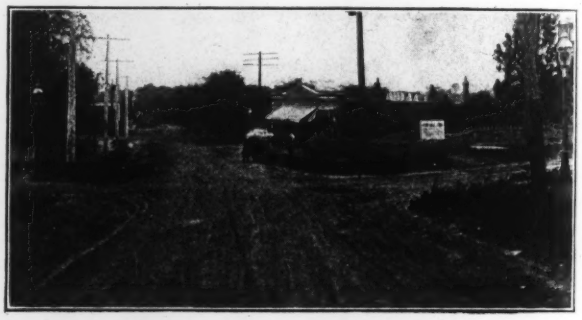
would be to take 40 ft. from the south side, leaving lot depths of 69 ft. Where owners in any one block may wish to close the alley this will be done by the city to permit of uniting Olive St. with that property immediately in the rear on Pine St.

After numerous meetings, hearings and public discussion the ordinance providing for the widening of Olive St. as recommended was passed on March 26, 1920. The estimated cost of this improvement is $2,000,000. To have secured the necessary width by cutting 20 ft. from both sides of the street would have cost over $1,000,000 more than the present plan, while to have taken all of the property on the south side of the street would have cost over $6,000,000, and would have resulted in a street 184 ft. wide, which is considered too wide for good business purposes.

Grand Ave., as previously stated, is the city's most important crosstown thoroughfare. Curiously enough, at its busiest part there are but two direct street crossings, thus causing increased traffic congestion where there is most need of relief. The Washington Ave. widening project, as previously stated, makes possible the elimination of one of these irregular intersections or "jogs." An ordinance passed in February 1919, provided for the elimination of two more "jogs," one at Lawton and Pine Sts., by connecting these two on the east with West Pine Boulevard on the west of Grand Ave., the connection being made in the form of a "Y," a direct right angle crossing of Grand Ave. being created. Still another "jog" will be removed by connecting Delmar Ave. on the west with Morgan St. to the east of Grand Ave., for which an ordinance has also been passed. Each of these "cutoffs" is designed to create new approaches to the business district from the west by creating new direct street connections.

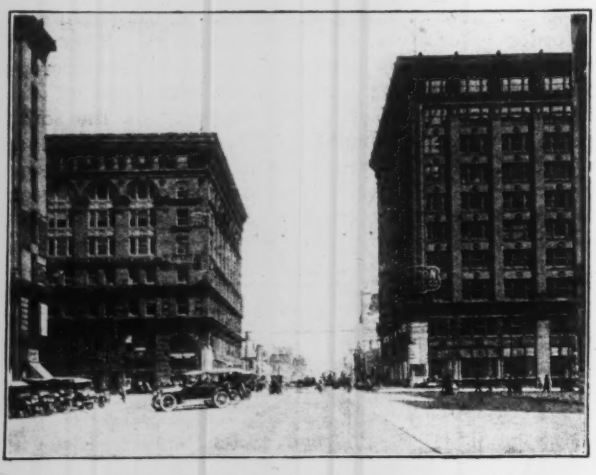
For the further improvement of the Delmar-Morgan approach to the business district, a slight correction in the width of Morgan St. will be made by increasing the present width of 50 and 60 ft. between High and 14th Sts. to 80 ft., to correspond with the present width of Morgan St. west of 14th St. This ordinance has also been passed.

Watson Road, one of the radial thoroughfares in the southwestern part of the city, will be increased from its present varying widths of 50 and 60 ft. to a uniform width of 80 ft., for which an ordinance was passed in April, 1917. The widening will be accomplished without much expense since there are as yet no buildings to be removed. It is approximately 2½ miles long.



WATSON ROAD: RADIAL STREET IN UNDEVELOPED DISTRICT

An ordinance for widening this street from its varying width of 40, 50 and 60 ft. to a uniform width of 80 ft., for a distance slightly more than two miles, was passed in 1918. Affords an excellent example of the possibility and desirability of widening important streets before the presence of expensive buildings make it very costly, if not prohibitively so.



PROGRESSIVELY CONTRACTING STREET WIDTH

Looking north on 12th St., St. Louis. In the foreground the street is 150 ft. wide. Between the two buildings it narrows to 80 ft. In the extreme distance north of Franklin Ave. it narrows to 50 ft. Twelfth St. is the principal entrance to the business district for all vehicle traffic from the northern part of the city. Under the present plan it will be widened to 100 ft. for a distance of 6½ miles. The two large buildings shown in the view will be left undisturbed except for arcading on the first floor of each in the first bay.

A most important crosstown thoroughfare will be created by the widening of Billon Ave. from 60 to 80 ft. and connecting it with Hampton Ave. by means of a viaduct over Manchester Ave., the Frisco and Missouri-Pacific railroads. Hampton Ave. will be extended and widened to 80 ft., thus making a continuous thoroughfare 4½ miles long in a section of the city now largely undeveloped. This new thoroughfare will be the principal approach to Forest Park from the south. Part of the widening has already been accomplished by dedication. The remainder is now under ordinance.

On Lindell Boulevard, between Grand and Channing Aves., a distance of 1,240 ft., there is now an irregular building line on the north side of the street resulting in an irregular street width of from 59 to 78 ft. This will be corrected by establishing a new building line on the north side of the street, giving a

uniform width of 80 ft. This ordinance was passed in 1918. It is interesting in that no immediate improvement is contemplated, simply the establishment of a building line is now authorized; owners of encroaching buildings to be paid for their property as they conform to the new line within ten years.

Another street opening for which the ordinance was passed April 2, 1919, is the connection of Skinker Road with Hodiamont Ave. in the extreme western part of the city. The opening will be 100 ft. wide, 2,400 ft. long and will destroy but few existing buildings. It will be part of a complete crosstown thoroughfare eventually to be created, more than 20 miles long, more than 10 miles of which already exist.

Other Appropriations

Progress on the development of Kings highway has also been made. An ordinance for the opening of the last section between Carondelet Park and Christy Park was passed in March, 1918. The viaduct over Broadway has recently been completed at an approximate cost of $60,000. In 1917 an appropriation of $40,000 was made for improving one section in Christy Park and a further appropriation of $40,000 for finishing the other section at Christy Park is included in the $24,000,000 bond issue to be submitted to popular vote on May 11. Between Easton Ave. and Natural Bridge Ave. the widening of Kingshighway from 100 to 150 ft. was held up for several years because of litigation growing out of tax assessments. In 1917 the city appropriated $163,000 which was paid into court and the city given possession of the land. In April, 1918, an ordinance for the improvement of this section was passed and the paving and planting will be completed this year.

It is estimated that the total cost of the various widenings and extensions outlined above will be approximately $10,000,000, exclusive of the improvement of the streets. Practically all of them have been made necessary as a result of the practice, until recently, of making all streets in the city 60 ft. wide irrespective of location or probable use. It is estimated that 75 or 80 per cent of all streets in the city are 60 ft. wide.

Little opposition has arisen to the various projects, due largely to the fact that all local civic organizations have been active in supporting them. The fact that a definite plan has been established and followed lifts each project out of the realm of local importance and makes possible its consideration from the standpoint of city-wide benefit and usefulness. For the past year the City Plan Commission has adopted the policy of leaving the initiative for street opening proceedings with owners of property affected in order to avoid undertaking too large a program at one time. This has not served to reduce interest and initiative, however, for petitions for four large projects—widening of Newstead Ave., widening of Florissant Ave., widening and extension of Easton Ave. from Cass Ave. to Morgan St., and the widening of Morgan St. from Grand Ave. to 3rd St.—have been circulated and filed with the City Plan Commission.

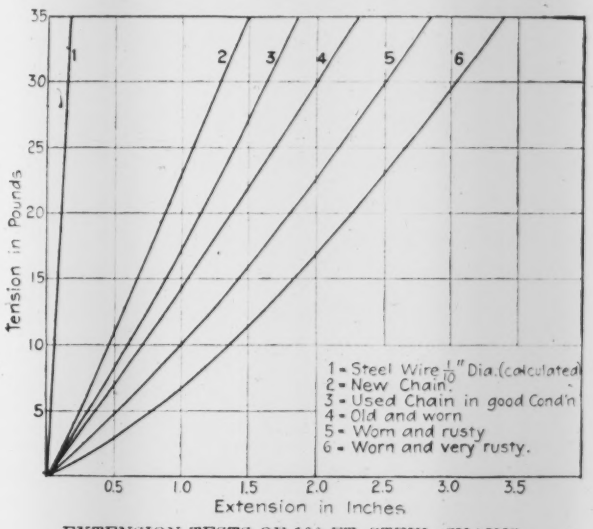
Address by Burnard Geen

The presidential address before the Society of Engineers (see *Engineering News-Record* April 1, p. 673) was delivered by Burnard Geen, whose name was incorrectly printed as "Green" in the issue referred to.

Tests of Extension in Steel Surveyor's Chains

THE use of the old survey chains is still so prevalent in Ireland that a paper describing extension tests of several such chains under varying tensions was included in the latest volume of the transactions of the Institution of Civil Engineers of Ireland. The test was conducted by J. T. Jackson, member of the Institution, and D. E. Allen, a student.

Five 100-ft. steel chains, one 100-ft. steel band chain, and two 66-ft. steel chains were tested in experiments.


Tension in Pounds
Extension in Inches
1 - Steel Wire 1/10" Dia. (calculated)
2 - New Chain.
3 - Used Chain in good Cond'n
4 - Old and worn
5 - Worn and rusty
6 - Worn and very rusty.

EXTENSION TESTS OF 100-FT. STEEL CHAINS

One handle of the chain to be tested was firmly fixed at a point in a floor and the other handle attached to a spring balance by means of a special hook. The extension was read on a boxwood scale fixed to the floor and the tension applied by means of an arrangement of two levers, so placed that the pull could be applied, the tension read on the spring balance and the extension read on the boxwood scale by one person. The spring balance was tested up to 35 lb. and found to be correct. A correction of +0.4 lb. was applied to the spring balance readings because of its use in a horizontal position. The zero readings were taken, not with the chain lying quite unstretched, but with a small tension of about ¼ lb., just sufficient to keep the links in their proper position.

The mean diameter of the wire in the five circular-section links varied between 0.1 in. and 0.11 in. The weight of the chains varied between 4¼ lb. and 5½ lb.

Results

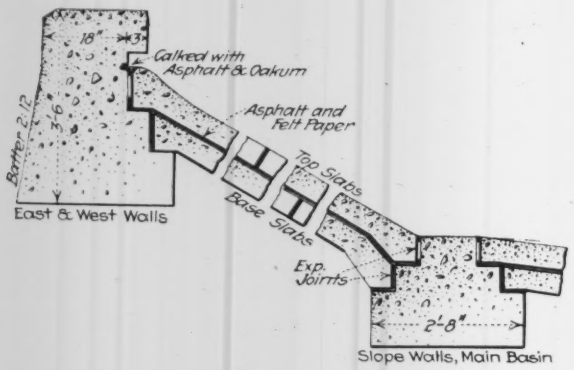
The results of the testing of the five 100-ft. circular-section chains, together with the description of their condition, is shown in the accompanying illustration. The curve marked No. 1 is plotted from the calculated result of stretching steel wire 100 ft. long and 0.10 in. diameter (approximately the same as that of the chains on the assumption that Young's modulus for this wire is 30,000,000 lb. per square inch.

The conclusions were as follows: Extension due to pull is almost altogether due to bending of the small links; is much greater for old and worn than for new or nearly new chains; and increases less rapidly than the load, especially in the case of the more worn chains.

New Coagulation Basin for Atlanta

Low Baffle Wall Forms Mud Section With Multi-Hoppered Bottom—Basin May Be Operated With Water at Various Depths

WHEN it was decided to increase the coagulating capacity of the water-purification plant of Atlanta, Ga., a radical departure in design, as compared with the old coagulating basins, was adopted. The old basin was baffled to give the water a zigzag course. The new basin, nearing completion in December, 1919,



DETAIL OF SLOPE PAVING FOR COAGULATION BASIN

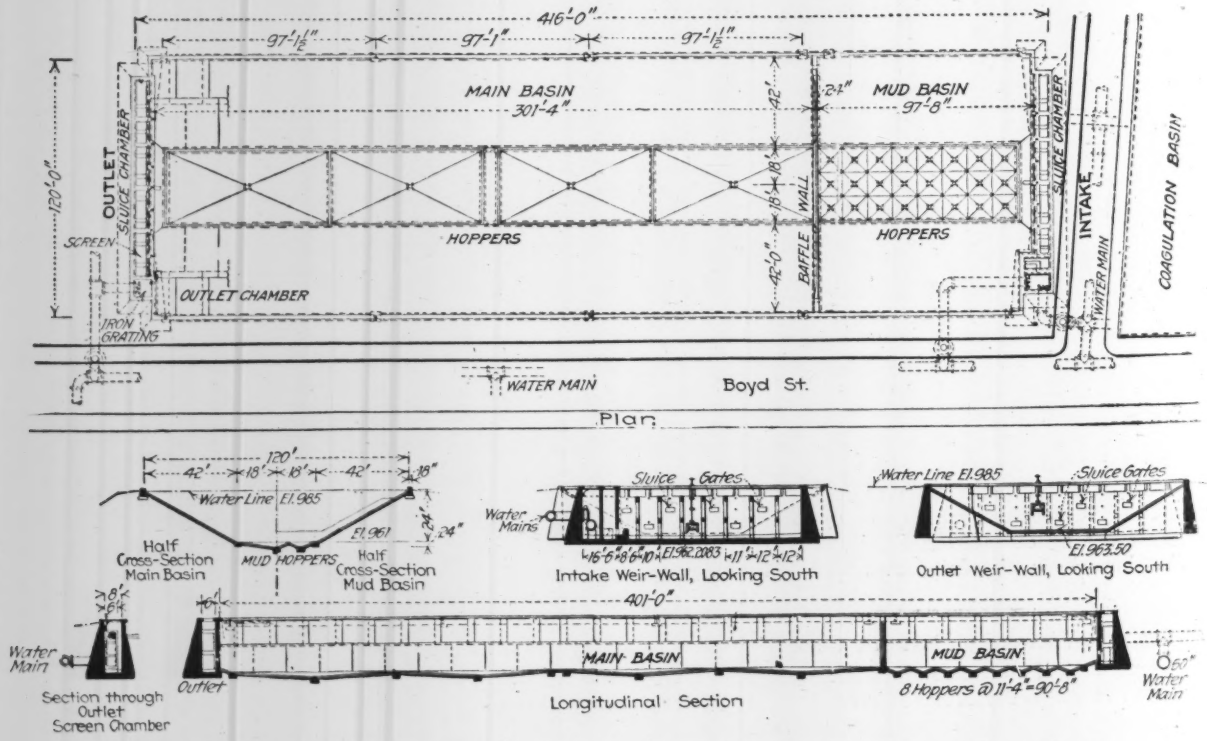
has a single, low baffle wall across its entire width about one-fourth of the distance from the inlet end, which divides the basin into a mud compartment with 24 hopper-bottom mud outlets, and a main compartment with three hopper bottoms in its entire length. All the hoppers, small and large, are connected to a mud outlet pipe system, there being no valves on the mud downtake from any one of the 27 hoppers. When the mud valves controlling either the mud or the main compartment are opened, the deposit will be forced out by the weight of the superincumbent water.

The new basin is 120 ft. wide and about 400 ft. long, with sloping sides from a level near the top. An intake or inlet extends across the basin, with a mixing chamber at one of its ends. An outlet chamber extends across the other end of the basin. The raw and coagulated waters may be passed at will over weirs or through gates at different levels, as shown on the cross-sections. A detail of the slope paving is also reproduced herewith.

The holding capacity of the old coagulation basin is 7,250,000 gal., and the capacity of the new basin is 5,500,000 gal., giving a total holding capacity of 12,750,000 gal. The average daily water consumption, based on pumpage, with no allowance for slip, was about 25,000,000 gal. in 1918, with an average peak load of 37,500,000 gal., and a daily range of rate of 42,000,000 to 12,000,000 gal. per day, the latter from 12:30 to 4 a. m.

Before the water goes to the coagulation basins it has had from 7 to 10 days' undisturbed sedimentation in one or the other of two large reservoirs that serve for both storage and sedimentation. After coagulation the water is passed through mechanical filters, now operating above their rated capacity. The filtered water is chlorinated.

W. Z. Smith is general manager of the water-works of Atlanta, and William Rapp is superintendent of construction. The general scheme for the new basins was worked up by Mr. Smith, Mr. Rapp and by C. E. Kauffmann, the latter making the detailed drawings. Mr. Kauffmann is engineer of bridges and estimates, under H. L. Collier, chief of construction of Atlanta.

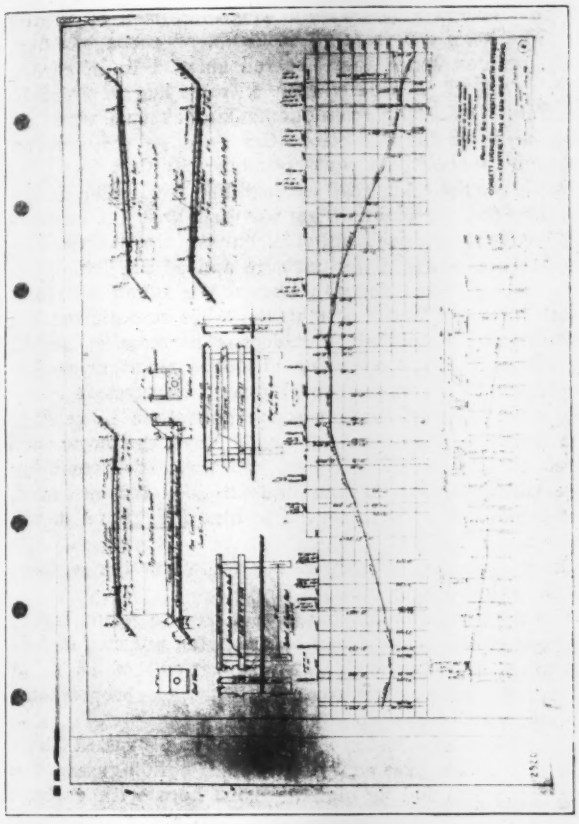


PLAN AND SECTIONS OF NEW 5,500,000-GALLON COAGULATION BASIN FOR ATLANTA, GEORGIA

Small Loose-Leaf Photos Replace Big Blueprints

BY CHARLES W. GEIGER
San Francisco, Cal.

REDUCED to a size suitable for a 5 x 7-in. loose-leaf note book, photographic copies of working drawings required by inspectors and others connected with a street improvement are used instead of large blue-



5 x 7-IN. LOOSE-LEAF REPRODUCTION OF BLUE PRINT

prints by the Engineering Bureau of San Francisco. The above illustrations shows such a sheet. Each person carrying one of the sets of photos is equipped with a magnifying glass, which makes the numbers and orders on the photographs as visible as they would be on a large blueprint. The system is also much more economical than providing blueprints.

Another photographic innovation which is rendering great service consists of taking pictures of a street before improvements have been started. The photograph shown was used in the preliminary study of readjusting an old pavement, changing the width of the street, and cutting down the knoll at the left. The various grades are marked on the slips of paper shown, which are fastened to steel pins stuck in the ground.

GRADES MARKED ON SLIPS OF PAPER ON STEEL PINS

Garbage and Refuse Collection and Hog Feeding at Salt Lake City

"The hogs squeal louder for uncooked garbage."

BY SANFORD J. TRUMAN
Treasurer Mountain States Feeding Co., Salt Lake City, Utah

THREE years' experience with the collection and disposal of the garbage, ashes and other waste matter of Salt Lake City have taught the writer some things that may be told with possible benefit to others. The main lessons, taking into account conditions prevailing here, are that horses and wagons are better than motor trucks and trailers for collection; that private disposal by burning in stoves and through individual collectors, not only becomes a public nuisance and does not effect an economic saving, but robs the contractor of much material which is the best hog feed in the world; that it is better to buy stock hogs than to raise pigs to feed; and that hogs thrive better on raw than cooked garbage.

The first contract between Salt Lake City and the Mountain States Feeding Co. was made in August, 1917, Under it the City of Salt Lake was to gather all the garbage and waste material that was offered in a reasonably separated state and deliver it to the Mountain States Feeding Co. at two separate loading stations, located one in the northern and the other in southern part of the city, from whence it was to be taken by us and disposed of at our feeding farm or dumping ground. On Aug. 5, 1918, we made a revised contract under which we agreed to gather and dispose of all the garbage, market waste, ashes, tin cans, rags, bottles and leather produced within the city limits (with the exception noted later) for a period of five years for $3,000 a month. This contract does not cover ashes or trade waste from business houses, public heating or lighting plants, or from apartment houses of more than four suites. It does entitle us, however, to all the eatable waste garbage from all these places.

In the business district collections are made daily between the hours of 7 p.m. and 3 a.m. In the residence section collection is made once a week in the day time, the city being divided into six zones, having a collection in each zone on a stipulated day of the week.

We desired the collection contract in order that we might secure a better separation of edible waste from the market waste, such as tin cans, bottles, etc. The separation has not been all that we desired under our present contract, but has been improved by educational work through publicity in the newspapers, by collectors and other agents of the contractor, and, where needed, through tagging the garbage receptacle with a 5¼ x 7-in. buff-colored card of explanation, headed boldly, "This Receptacle is Not Emptied for the Reason the Garbage and Waste Matter is Not Properly Separated," followed by instructions that if observed by the householder, will ensure collection. The city administration is co-

operating with us and the separation is therefore rapidly improving.

Another difficulty encountered is the burning of garbage in winter by the residents of apartments and of houses where stoves are used. We make pleas for the saving of this valuable hog food. Moreover, when we took the work under our present contract, some 65 individuals with unsanitary conveyances were coming into the city at all times during the day and night to get garbage from certain restaurants and eating houses. They were reluctant to give up this garbage and about twenty of these independent haulers banded together and brought suit to enjoin the city from the enforcement of the garbage collection ordinance. They carried the case into the District Court but were defeated.

Before taking up the means of collection employed within the city limits, it may be noted that the garbage only is transferred at a special station within the city limits to specially constructed railway cars and transported over the lines of the Bamberger Electric Railroad Co. to our feeding farm, seven miles north of Salt Lake City, where a switch runs directly into our main building. All other waste matter is delivered to a dumping ground within three miles of the business district.

From August, 1918, until August, 1919, collections were made with two 3½-ton trucks and one 2-ton truck, each truck trailing one or two 2½-ton trailers, all having specially constructed steel dumping bodies and with compartments to keep the garbage separated from other material. In addition to the truck and trailer equipment we used five horse-drawn wagons. We found that owing to the excessive costs of upkeep on our trucks and trailers, the abuse which they received from the class of labor we had to have for the operation, and because our trucks were continually stopping and starting up when collecting from house to house, that we were operating under tremendous upkeep expenses. In August, 1919, we discontinued the use of all trucks and trailers with the exception of a 3½-ton Federal truck with trailer, which is used in the business district at night. This truck and trailer, supplemented with two two-horse outfits with specially constructed bodies on the wagons, collect every night all the garbage and other material which we have to collect within the business district. In the residence district we use horse-drawn conveyances exclusively. We are operating 16 two-horse teams, each team drawing a wagon having a specially constructed body with movable partitions so that the garbage and other waste material are kept separate, and one outfit can serve its own allotted territory.

At the sorting dump the tin cans, rags, bottles, leather and other materials are salvaged, the cans being sold to the Utah Copper Co. for smelting purposes. What other wastes are not salvaged proves a most excellent filling material and are eagerly sought after to be used in low places which owners desire to have filled.

Our hog farm comprises 60 acres, but only a small proportion of this area is used. Our main building is 70 x 140 ft. in plan and we have 48 colony houses. Altogether, the buildings cover about six acres. Each colony house will accommodate 50 hogs and includes a 9 x 64-ft. shelter and a 9 x 64-ft. open feeding floor, besides which there is a 15 x 64-ft. runway. The hogs both eat and sleep on board floors, which we find are more healthful than concrete, since they hold less moisture. Our hogs are never bothered with rheumatism. Flowing wells supply fresh water, which is conveyed to a standpipe and thence is piped to a trough at each colony house. Hose can be attached to our water system which allows us to give the hogs a shower bath during the hot summer months and also gives us fire protection for our colony houses.

At the beginning of our operations we expected to buy brood sows and raise our own pigs. This was soon found to be disadvantageous, since which time we have bought feeders and stockers weighing from 80 to 100 lb. The hogs eat from 15 to 20 lb. of garbage a day each, besides which they are fed about 1 lb. of corn a day. This gives a daily gain on each hog of from 1¼ to 1¾ lb. Deducting from our haulage expense what the city pays us for collection, the garbage costs us an average of about 5.6 cents per hog per day.

At a considerable cost we installed a digester at the garbage feeding plant. This was primarily for recovering grease from dead animals, but we also proposed to extract grease from the garbage and at the same time cook the garbage for the hogs. We found within a short time that the raw material as it comes from the restaurants, hotels and residences is more palatable. The hogs squeal louder for uncooked than for cooked garbage. There was not much profit in the grease which we extracted and there was no advantage in cooking the garbage, for after 30 or 40 days the hogs soon tired of the cooked garbage. In fact, it's something like eating quail. A man finds it good for one meal, but would tire of it is served to him daily for a month or two.

In the winter, before feeding we warm the garbage by injecting steam into it.

Old hogs are double treated with cholera serum before they enter our pens. Then before being put on full feed we allow what we call a "sweat period" of 18 to 21 days. We have never lost a hog that has been treated in this way.

The Mountain States Feeding Co. has invested $150,000 in its collection equipment, land, buildings and live stock. It has fed as high as 2,500 hogs with garbage at a time and during the winter months it feeds an average of 1,500 hogs. In the immediate future and with the proper separation and conservation of all the garbage and edible waste matters coming to us under our present contract, we should be able to feed on an average of 3,000 to 3,500 hogs from Salt Lake City's population of 135,000 people.

Ohio Health District Law Weakened

A considerable weakening of the Ohio health district law outlined in *Engineering News-Record*, Dec. 25, 1919, p. 1067, has been effected by legislative amendments made and passed this year. These amendments (*American Journal of Public Health*, March, 1920, p. 285) permit part-time instead of full-time health officers, cut out civil service provisions, leave observance of many important features of the original law optional with local boards of health, and make separate health districts of cities of more than 5,000 instead of 25,000 as under the old law. The financial stringencies of Ohio municipalities in general and a Supreme Court decision indicating that the original law would be in part unconstitutional are given as reasons for the amendments to the health district law.

Tile Drainage of Irrigated Land for Seepage Relief at Twin Falls

Wells on Surveyed Line Drilled in Lava Rock to Water-Bearing Strata—Size of Drain Tile Based on Yield

By Roger M. Adams
Superintendent of Maintenance Twin Falls Canal Co., Twin Falls, Idaho

On the 240,000-acre tract of the Twin Falls Canal Co. a peculiar form of drainage work is carried out, which has been developing through the last eight years. Most of the seeped areas are located parallel to deep natural channels, or coulees, the water percolating toward the coulees being confined in porous strata between successive lava layers. Along the coulees the porous strata are sealed putting the water under pressure. Drilled wells tap these water-bearing strata and the resulting artesian flow is carried by an underground tile system to the coulees. The method of draining is as follows:

1. A contract is made with the land owner wherein the company secures whatever easements for right-of-way are needed to properly execute the work.

2. A survey is made and stakes set showing the skeleton of the tile system and outlet.

3. Six-inch wells are drilled with a deep-well rig, and where necessary a 5⅜-in. well casing is placed in the holes, which are located on the edge of trench lines.

4. From the quantity and duration of the flow from the wells the size of each branch line of tile is computed, taking into consideration the grade of the line.

5. The outlet is designed for a load three times as great as the sum of all the branches.

6. The trench diggers, compressor men, and air-hammer men then move to the job with their machines and tools and commence work, while the well drills are moved to the next job. The wells are tapped at a depth of 6 ft. or more and the tile laid at 6 ft. depth to the outlet.

7. After the tile is laid and covered with gravel to a depth of from 3 to 6 in. the trench is backfilled, first with lava rock blasted from the trench, then with topsoil.

8. A stream of water is turned onto the upper end of the backfill and conducted along it in corrugations provided until no appreciable amount of the water sinks. This puddling is done very carefully, and all possible attention is given to getting the sides of the trench into a well-sloped-off condition so that the wet puddle, when drying, sinks against the sides of the trench as a wedge in a slot.

9. All trees and willows or other plants that send roots to water are cut down to a distance of 60 ft. from any tile line and the stumps burned.

10. A deep furrow is plowed parallel to and 5 or 6 ft. from each side of every tile line to conduct all waste and irrigation water into channels provided, which do not deposit the water on newly backfilled trenches, for at least one season. Farming the land drained is then possible, and it is expected of the owner if the season is not too far advanced.

In item 7 above, mention is made of the lava rock which is displaced from the trenches. The entire tract is underlaid at a greater or less depth by this lava rock. Volcanic ash forms the topsoil, in depths varying from a few inches to 60 ft., the most usual depths being 6 to 12 ft. over the "seeped" areas.

The lava was not all deposited in the same flow, but at intervals between which there must have been considerable periods of no flow. To bear out this idea, there is found in some localities a stratum of washed sand; in others, a clay strata; in others, broken lava of considerable depth, showing unmistakable signs of the evaporation of water.

A log is kept of all wells drilled, and these records are studied for information as to the stratification, width of opening laterally between the strata, and the depth of the opening which carries the water. Drilling is carried on only until the water-bearing stratum is reached. A well that shows an excessive pressure, forcing the water from it, is supplied with more area by drilling holes close to it before the rigs are moved from the spot. The wells are placed closely enough to enable one line of tile to tap the group. In this manner the flow of the water into the tile is rendered a gravity flow only.

The general slope of the land is northwest. For this reason drilling is always carried forward from the south toward the north, on any projected tile line. In this way fewer unnecessary holes are put down. Observation wells are put down 200 or 300 ft. uphill from the end of each tile line for purposes of observation and check on the success of the work in lowering the water-table to the desired depth.

Waste Channels

In most cases, irrigation waste channels are used for the outlets of the tile systems. There are few of these wastes that are artificial; 95 per cent of the channels so used are coulees. The larger coulees, and natural channels—even the Snake River—are in deep depressions which have perpendicular walls. The strata of the walls are not open at intervals at various depths, as is the land farther back from the channels, but is sealed up. There are none of the clay, sand, or spongy, incinerated material strata to be found on the coulee walls, only a seamed lava wall. The underground outlets for the water that percolates downward from the irrigated lands of the tract have no unconfined outlet at the edges of the coulees, and this barrier is of considerable thickness laterally from the edges of the coulees, hence drilling for the relief of pressure on the wells is not attempted close to the edge of coulees. The study of the logs has developed the fact that the greatest pressure on wells is obtained from wells that are drilled at the break of the slope near the crown of the swale that natural causes have made at the border of the coulees, and some ten or twenty rods from them.

From the above it may be seen that the "seeped" area is near the natural channels. That is where the first of the wet area showed up, and the progress was backward, or uphill. Also it may be one reason why the seeped area is relatively small—0.57 per cent of the total area of the tract. There is not a great probability of more than 1 per cent showing up in the future.

The cost of the drainage work is divided among those benefited. Fifteen dollars per acre drained is charged the owner of the land. The remainder of the cost is assessed to the whole acreage under the tract, and amounts to about 40c. per acre, and is added to the general operation and maintenance charge.

Rectangular Co-ordinates Used in Surveys and Maps

Grid System Based on Lambert Projection, Employed by Armies in France, Is Recommended for Civilian Practice

By H. A. Foster
Former Second Lieutenant, 29th Engineers, U. S. Army

Editor's Note: *This article introduces and explains the advantages of certain methods of computations by a system of rectangular co-ordinates as adapted to U. S. Army practice from that of the French. Another article by Lieutenant Foster describing such methods and their application in simplifying triangulation will be published soon.*

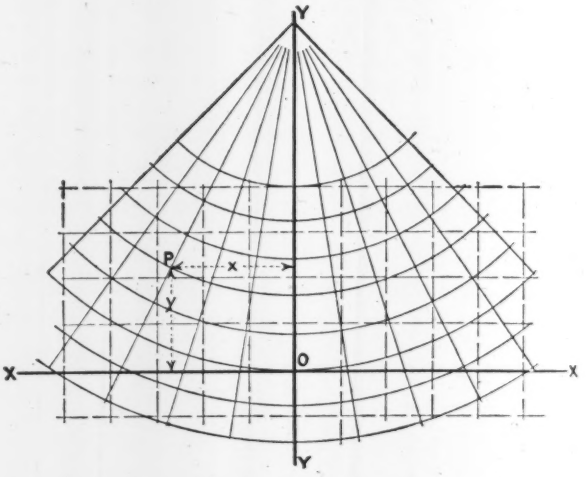
In the solution of triangulation problems for military surveys in France, certain methods of computation were used by the American army which are rather new to engineers in this country. The French and British armies had developed special methods for their own use before American participation in the war. The French system differed considerably from that used by the British; and it is the French method, with some modifications, which was adopted by the American army. To explain the method, it is first necessary to describe the conditions under which they are used. For this purpose, a brief description will be given of the system of military mapping which was used in France.

The French military map is based on Lambert's "Conformal Conic Projection." The following publications of the U. S. Coast and Geodetic Survey afford a complete discussion of the Lambert projection: "The Lambert Conformal Conic Projection," Spec. Pub. No. 47; "Lambert Projection Tables for the United States," Spec. Pub. No. 52; "General Theory of the Lambert Conformal Conic Projection," Spec. Pub. No. 53. In this projection the meridians are represented by straight lines converging to a common point and the parallels of latitude are represented by concentric circles with this same point as their center. The angles between successive meridians and the distances between the parallels are determined by formulas which depend on certain mathematical properties of the projection. These formulas need not be considered here. The linear scale of the projection is not a constant, but varies slightly for different latitudes. But the projection is "conformal" throughout; that is, the angle between any two lines on the projection is the same as the angle between the corresponding lines assumed to be drawn on the earth's surface.

On this projection, the intersection of a certain meridian and parallel is chosen as the origin for a system of rectangular co-ordinates. The given meridian is the Y-axis, and the X-axis is drawn through the origin, perpendicular to the Y-axis, or tangent to the parallel of latitude at that point. The whole map is then divided up into a system of squares by drawing lines parallel to the X-axis and Y-axis, the distance between successive lines being generally one kilometer. As can be seen on the figure, the Y-lines will not be parallel to any meridian except the meridian through the origin; and similarly, the X-lines will not be tangent to any parallel of latitude except where they intersect this same meridian.

Now consider any point, *P*, whose latitude and longitude are known. It is possible, by certain formulas, to compute the rectangular co-ordinates of this point with respect to our X- and Y-axes. This will give us the values x and y, which represent the distance from *P* to the Y- and X-axes respectively.

It will readily be seen that these rectangular co-ordinates, expressed in yards or meters, are much more convenient to use than the original geographic co-ordinates of the point, which were expressed in degrees of longitude and latitude. In France, the military



authorities knew the geographic co-ordinates of a great many points, mostly church steeples, which were scattered all over the country. It was not a difficult matter to convert these into the corresponding rectangular co-ordinates, so that each of these points was accurately located by its X- and Y-co-ordinates. Then the co-ordinates of any new point which it was necessary to locate, such as the telescope in an observation post or the directing gun of a battery, were determined by running surveys connecting the new point with two or more of the known points; and the co-ordinates of the new point were computed.

Advantages of System

To illustrate the advantages of this system, consider the case of our battery, whose rectangular co-ordinates have been determined as described above. The battery commander desires to fire on a certain target which is behind a hill or some other feature that screens it from his view. But the co-ordinates of the target have been determined by some method, such as direct observation from two different points, or aerial photographs. Knowing the co-ordinates both of his battery and of the target, the battery commander can readily compute the distance to the target—i.e., the range—and the direction of the target. He can, therefore, aim his guns accurately upon the target without ever being able to see it.

The system of squares that has been described was commonly known as a "grid system." It should be observed that the grid system is independent of the type of map projection on which it is used. The system of projection must first be selected; then the grid is superimposed on the projection. Also, the grid may be applied to the projection in any given manner. The point of origin may be shifted as desired. But of course it is

always convenient to have one of the axes of co-ordinates parallel to some meridian.

Most of the official maps published in the United States are made on the Polyconic projection. The application of a grid to this projection is somewhat more difficult than in the case of the Lambert projection. So it has been proposed to use the Lambert projection for certain maps, especially military maps, where the use of a grid is very desirable. Tables in the publications cited above give the data necessary for the application to the whole of the United States of a system of rectangular co-ordinates based on the Lambert projection. Some work has also been done toward applying a grid system to the polyconic projection. These tables make it possible to determine the rectangular co-ordinates of any geodetic point whose latitude and longitude are known, thereby avoiding the labor required in solving a formula. So for any section of the country in which certain known geodetic points are available, a grid system can readily be established; and any future surveys in that section can be based on rectangular co-ordinates.

However, it is not necessary to know the latitude and longitude of any point in order to base the survey on rectangular co-ordinates. Instead, co-ordinates can be assumed for the starting point of the survey, and the Y-azimuth of the starting line (that is, the angle it makes with the Y-axis) can also be assumed. The axes of the grid system are therefore determined, and the survey can be completed without reference to latitude or longitude. Thus it is possible to compute any survey by rectangular co-ordinates.

Practical Application of System

For a practical application of the system consider a large irrigation or drainage project. To lay out the plans for such work extensive surveys are necessary and by which many stakes or monuments are located. These are plotted on the map as reference points. As the work progresses it becomes necessary to locate many additional points by extension from these reference points. All of this work will be greatly simplified if the survey has been computed in terms of rectangular co-ordinates. Every known point will then be located by its individual co-ordinates, which can be used both for plotting it on the map and for relating it to other points.

In a later article certain methods of computation will be described which greatly simplify the solution of triangulation that is based on a grid system. These methods of computation involve a semi-graphic adjustment of the results of the triangulation. This adjustment does not give results which are as refined and precise as those given by the method of least squares, which is commonly used in this country. But the results will be quite accurate; and the work involved is very much less than is required in making a least squares adjustment. The graphical methods used also have a special advantage in that they indicate very clearly the amount of adjustment that is necessary; and they show very distinctly whether any of the observations were inaccurate or wild. The methods may appear at first to be somewhat involved, chiefly because they are different from what most surveyors are accustomed to. Nevertheless after a little practice, they are found not to be difficult, and in plane surveys where rectangular co-ordinates can be introduced, these methods undoubtedly have very great advantages.

Analysis of New Orleans' Rainfall Statistics for Twenty-five Years

Based on records of rainfalls in New Orleans, La., for the 25-year period from 1894 to 1918 inclusive, a table has been compiled giving the annual maximum amount falling in inches within stated periods ranging from three minutes to twelve months. The information was given in the latest annual report of George G. Earl general superintendent, Sewerage and Water Board.

Time Period	Greatest	Date of Occurrence	Average	Least	Date of Occurrence
3 min	0 63	Dec. 25, 1916			
5 min	0 84	Dec. 25, 1916	0 46	0 30	'97-'98-'99-'08
15 min	1 73	Dec. 25, 1916	1 09	0 68	'08
30 min	2 64	Apr. 27, 1900	1 71	1 00	'97
45 min	2 99	Oct. 29, 1918	1 96	1 30	'97
1 hour	3 53	Oct. 29, 1918	2 16	1 39	'06
2 hours	4 66	Mar. 22, 1912	2 71	1 58	'02
3 hours	5 80	Mar. 14 and 15, 1903	3 09	1 66	'08
4 hours	6 60	Mar. 14 and 15, 1903	3 21	2 01	'08
5 hours	7 02	Mar. 14 and 15, 1903	3 52	2 05	'08
6 hours	7 10	Mar. 14 and 15, 1903	3 62	2 10	'08
7 hours	7 30	Mar. 14 and 15, 1903	3 74	2 20	'08
8 hours	7 40	Mar. 14 and 15, 1903	3 83	2 30	'08
9 hours	7 50	Mar. 14 and 15, 1903	3 94	2 40	'08
10 hours	7 60	Mar. 14 and 15, 1903	4 01	2 50	'08
11 hours	8 37	Apr. 25, 1907	4 11	2 60	'04-'08
12 hours	8 75	Apr. 25, 1907	4 19	2 60	'04
13 hours	8 81	Apr. 25, 1907	4 21	2 60	'04
14 hours	8 81	Apr. 25, 1907	4 29	2 60	'04
15 hours	9 06	Apr. 25, 1907	4 33	2 60	'04
16 hours	9 21	Apr. 25, 1907	4 37	2 60	'04
17 hours	9 30	Apr. 25, 1907	4 40	2 60	'04
18 hours	9 35	Apr. 25, 1907	4 43	2 60	'04
19 hours	9 40	Apr. 25, 1907	4 47	2 60	'04
20 hours	9 50	Apr. 25, 1907	4 50	2 60	'04
21 hours	9 60	Apr. 25, 1907	4 53	2 60	'04
22 hours	9 70	Apr. 25, 1907	4 56	2 60	'04
23 hours	9 75	Apr. 25, 1907	4 59	2 60	'04
1 day	9 80	Apr. 25, 1907	4 63	2 60	'04
2 days	9 90	Apr. 25-26, 1907			
3 days	9 90	Apr. 25-26, 1907			
4 days	11 51	Apr. 22-25, 1907			
5 days	12 73	Apr. 21-25, 1907			
6 days	12 82	Apr. 21-26, 1907			
7 days	14 01	Sept. 29-Oct. 5, 1915			
8 days	14 12	Sept. 29-Oct. 6, 1915			
15 days	22 24	Sept. 29-Oct. 13, 1915			
30 days	23 00	Sept.-Oct., 1915			
1 mo.	16 01	Sept., 1898	10 10	5 84	'17
2 mos	26 62	Apr.-May, 1907	16 00	9 14	'02
3 mos	30 81	Mar.-May, 1912	21 00	11 65	'02
4 mos	36 48	July-Oct., 1915	24 00	12 86	'02
5 mos	41 75	June-Oct., 1915	28 00	14 90	'02
6 mos	47 69	1912	33 00	17 28	'02
7 mos	51 58	1912	37 00	21 53	'02
8 mos	55 19	1912	40 00	24 98	'02
9 mos	59 87	1912	44 00	28 83	'02
10 mos	67 73	1911-1912	49 00	31 27	'17
11 mos	71 74	1911-1912	52 00	31 53	'17
12 mos	74 68	1912	53 83	33 51	'17

The following tabulations give maximum, minimum and average monthly rainfall for the same 25-year period:

INCHES RAINFALL PER MONTH

Month	Maximum	Minimum	Average
January	7 65	0 75	3 47
February	13 27	1 29	4 58
March	11 77	1 23	4 37
April	12 64	0 66	4 71
May	13 98	0 10	4 09
June	10 48	1 21	5 19
July	10 93	2 51	6 20
August	9 21	3 01	5 55
September	16 01	0 39	5 29
October	12 14	0 60	2 95
November	6 32	0 21	2 38
December	13 18	1 62	4 90
Per annum	74 68	33 51	53 82

Making Brick from Waste Granular Granite

Waste granite in the Barre (Vt.) district accumulates in the quarries in large quantities. Its removal is expensive and recent investigators at Montpelier, Vt., have been experimenting with it in the production of a brick similar to sand-lime brick. Granules of granite are mixed with lime, moulded and hardened under steam pressure. The brick are said to be of excellent quality for structural purposes, according to the Bureau of Mines.

Aggregate Proportions for Equal Strength Concrete

Tables Give 135 Combinations of Fine and Coarse Aggregate Producing Equal Strength Concrete—Most Natural Gravels Included in Tabulation

By A. N. Johnson
Consulting Engineer, Portland Cement Association

A method of applying fineness-modulus theory of proportioning concrete to actual field use in concrete highway construction as outlined in addresses before the American Road Builders Association and various state and local engineering societies.

AGGREGATES having far greater ranges of size than have been considered permissible can be employed for concrete pavement. The concrete mixtures from all will be equally strong and uniformly workable. Proper proportions are all that is necessary. These proportions can be determined in the field by means of tables, which embrace the ranges of sizes and gradings ordinarily exhibited by natural gravels. Great extension by this means of the sources of materials available for concrete road construction is accomplished, and one of the most troublesome problems of the road builder is materially simplified.

Numerous tests conducted by Prof. D. A. Abrams of Lewis Institute, Chicago, have demonstrated that by determining the fineness modulus (*Engineering News-Record*, April 17, 1919, p. 758), it is practicable to make concrete of equal strengths from quite dissimilarly graded materials. For example. one aggregate may range from 3-in. pieces to the finer sand particles, while the second may contain no pieces over 1-in. in size and yet, by varying the proportions of cement, each of these aggregates may be used and the strength of the resulting concrete will be the same.

Present Specifications Exclude Usable Materials

Many supplies of aggregates now excluded by the narrow restrictions of our specifications, may be employed and just as good concrete produced as that made under our present specifications. We have been somewhat inclined to develop a standard specification and have lost sight of the fact that it is not the specification that is to be standard but rather the product. If concrete possessing the same strength and durability can be made from aggregates having various gradings and limiting sizes then there is no reason to adhere to specifications which confine the selection of aggregates to those of a particular grading and exclude all others.

Under our standard specifications for fine aggregate, we are limited to the use of material varying from ¼-in. size down to the finer materials, specifying that it shall be reasonably well graded between the smaller and larger particles. Suppose, however, there is available a quantity of sand containing no particles larger than ¼-in., are we to throw away these sands, or may we use them, varying the proportions so as to produce the same strength concrete as is obtained with the sand containing ¼-in. particles?

Our specifications today for coarse aggregate, while they vary somewhat more than for fine aggregate, restrict the choice of materials to very narrow limits, the sizes usually specified varying from ¼ in. to 2in., some to as high as 3 in. and a number limiting the larger size to 1½ in. But we have at hand, let us say, a large amount of material which contains no particles less than 1 in. in size, varying from that to 2 in. or possibly to 3 in., or there is other material available containing nothing less than ½ in. and perhaps nothing over 1 in. The question is, can we use aggregates, which vary so widely from our present specifications, in such a way as to produce concrete as strong and durable as with the aggregates that comply with our present specifications. From Prof. Abrams' work we know the answer to be "yes." Also Prof. Abrams has prepared Table I and II which puts the results in a practically available form.

Tables Based on Present Practice

The basis upon which the tables have been calculated is the production of a concrete that experience has shown will have sufficient strength and durability for its purpose. There have been many miles of concrete roads built using a 1:2:3 mixture with the fine aggregate varying from ¼ in. to the finer particles and the coarse aggregate varying from ¼ in. to 1½ in. or 2 in. Such a concrete tested under laboratory conditions, using 6 x 12 in. cylindrical test specimens, and with a plasticity that secures a practical workability, gives very closely at 28 days a compressive strength of 3,000 lb. per square inch. This was taken as a basis upon which the tables have been prepared.

Five different fine aggregates were selected, varying, as the table will indicate, from the finest which contains no particles over $\frac{1}{28}$-in. and others not over $\frac{1}{4}$, ½, 1 and 3 in. in size respectively. A wide selection of coarse aggregates is given beginning with the first group which has the smaller limit of size at ¼ in., while the larger limit varies from ¾ in. to 3 in. In the second group the lower limit for the coarse aggregate is ⅜ in., with sizes for the upper limit varying from ¾ in., to 3 in. Similarly there are groups with the lower limit at ½ in., ¾ in., and 1 in., respectively, the upper limits in each group varying in sizes to 3 in., making in all 27 variously sized coarse aggregates, each in turn combined with five different fine aggregates or sands, thus making 135 combinations of fine and coarse aggregates each of which is proportioned so as to produce under practical working conditions as to consistency the same strength concrete.

In all cases it is to be assumed that all aggregates that are to be used, irrespective of size or grading, are to be of material structurally sound, clean and free of organic impurities. Also it should be observed that Professor Abrams' tests demonstrated that the resistance to abrasion of conretes varied as the compressive strength, the greater the strength, the greater the resistance to wear; and that conretes of equal crushing strength gave about equal resistance to abrasion.

In the practical application of the tables we first have to define how to determine what is the upper limit of size for a given aggregate. Should any sand containing a few ¼-in. particles be classed as one varying from zero to ¼ in., or should there be required a certain

percentage of material between the ¼-in. size and the next lower limit, as shown in the table, which is ⅛ in.? The proper allowance, Professor Abrams tells us, should be 15 per cent; that is, a fine aggrategate with ¼-in. particles which did not contain 15 per cent by volume of the material passing the sieve with eight openings to the inch, should be classed as ⅛-in. sand, not ¼-in.

The following rule is to be applied to determine the limits of sizes for the coarse aggregate: There shall be not less than 10 per cent of material between the largest size and the next smallest size shown in the table. Thus a coarse aggregate to be classed as 2½-in. size shall have not less than 10 per cent of the material between the 2½-in. size and the 2-in. size it should be classed as 2-in. providing there should be at least 10 per cent of the material retained upon the 1½-in. screen.

The lower limit of size of a coarse aggregate shall be the largest size shown in the table for coarse aggregate below which there is not to exceed 10 per cent by volume of the material. Thus a coarse aggregate in which the lower limit of size is to be 1 in. should be an aggregate in which there is not to exceed 10 per cent by volume of the material passing the 1-in. screen. In all coarse aggregates if there is to exceed 5 per cent of the volume passing a ¼-in. sieve, then such excess shall be considered as fine aggregate and the amount of fine aggregate to be used is to be modified accordingly.

It will be noted that in addition to the proportions regulating the combination of the various fine and coarse aggregates with the unit quantity of cement, there is also given in the tables the quantities of the materials to be used to make 1 cu. yd. of concrete. These quantities are in barrels and hundredths of barrels for cement and in hundredths of subic yards for the aggregates. The quantities shown do not make allowance for waste from any source, so that for practical estimates they should be increased as experience in handling the work according to the particular method to be employed indicates as necessary.

It will be supposed that one sand is that usually specified, from ¼ in. down, and must be shipped in at a cost of $2 per cubic yard; that one coarse aggregate, varying from ¼ in. to 2 in., must also be shipped in at a total cost of $3 per cubic yard; that there is available locally a supply of sand and coarse aggregate, each being rather fine, the sand varying from ⅛ in. down which costs $1.50 per cubic yard, while the coarse aggregate varies from ¼ in. to 1 in. and may be secured at a cost of $2.50 per cubic yard. The cement in each case is assumed to cost $3 per barrel. The cost of a cubic yard of concrete using the materials to be shipped in would then be as follows:

1.52 bbl. cement at $3	$4.56
0.43 cu.yd of sand at $2	0.86
0.81 cu.yd. of coarse aggregate at $3	2.43
Total cost of 1 cu.yd. concrete	$7.85
Using local materials the cost would be:	
1.72 bbl. cement at $3	$5.16
0.46 cu.yd. of sand at $1.50	0.69
0.66 cu.yd. of coarse aggregate at $2.50	1.65
Total cost of materials for 1 cu.yd. concrete	$7.50

PROPORTIONS AND QUANTITIES OF AGGREGATES PER CUBIC YARD OF 3,000-LB., 28-DAY CONCRETE

SIZES		FINE AGGREGATES, SCREEN OPENINGS PER INCH															
COARSE AGGREGATES Inches	Cement in Barrels Aggregates in Cubic Yards	0-28			0-14			0-8			0-4			0-⅜ In.			
		Cement	Fine	Coarse	Cement	Fine	Coarse	Cement	Fine	Coarse	Cement	Fine	Coarse	Cement	Fine	Coarse	
No. 4 Screen to ¾	Proportions	1	1.3	2.4	1	1.6	2.4	1	1.8	2.3	1	2.0	2.3	1	2.7	1.5	
	Quantities	1.96	.37	.69	1.85	.44	.66	1.82	.48	.62	1.75	.52	.59	1.79	.72	.40	
No. 4 Screen to 1	Proportions	1	1.3	2.7	1	1.6	2.6	1	1.8	2.6	1	2.0	2.5	1	2.6	1.8	
	Quantities	1.90	.36	.76	1.77	.42	.68	1.72	.46	.66	1.67	.50	.62	1.72	.66	.46	
No. 4 Screen to 1½	Proportions	1	1.2	3.1	1	1.6	3.2	1	1.7	3.1	1	2	3	1	2.4	2.4	
	Quantities	1.82	.32	.84	1.68	.40	.79	1.63	.41	.75	1.61	.47	.72	1.62	.57	.57	
No. 4 Screen to 2	Proportions	1	1.2	3.5	1	1.5	3.5	1	1.6	3.7	1	1.9	3.6	1	2.2	3.1	
	Quantities	1.75	.31	.90	1.63	.36	.85	1.55	.36	.85	1.52	.43	.81	1.53	.50	.70	
No. 4 Screen to 2½	Proportions	1	1.1	3.8	1	1.4	3.9	1	1.6	4.0	1	1.8	4.0	1	2.1	3.5	
	Quantities	1.72	.28	.97	1.58	.33	.91	1.51	.35	.89	1.49	.40	.88	1.50	.46	.78	
No. 4 Screen to 3	Proportions	1	1.1	3.9	1	1.4	4.1	1	1.5	4.1	1	1.7	4.1	1	2.0	3.7	
	Quantities	1.69	.28	.97	1.58	.33	.97	1.49	.33	.90	1.49	.37	.90	1.49	.44	.81	
⅜ to ¾	Proportions	1	1.3	2.3	1	1.7	2.3	1	1.9	2.3	1	2.2	2.2	1	2.8	1.4	
	Quantities	1.96	.37	.67	1.85	.46	.63	1.82	.51	.62	1.75	.57	.57	1.79	.75	.37	
⅜ to 1	Proportions	1	1.3	2.6	1	1.7	2.6	1	1.9	2.5	1	2.2	2.4	1	2.7	1.7	
	Quantities	1.90	.36	.74	1.77	.44	.68	1.72	.48	.64	1.67	.54	.59	1.72	.68	.43	
⅜ to 1½	Proportions	1	1.3	3.0	1	1.7	3.0	1	1.9	3.0	1	2.1	2.9	1	2.6	2.2	
	Quantities	1.82	.35	.80	1.68	.43	.75	1.63	.46	.73	1.61	.50	.68	1.62	.63	.53	
⅜ to 2	Proportions	1	1.3	3.3	1	1.7	3.4	1	1.8	3.5	1	2.0	3.4	1	2.4	2.9	
	Quantities	1.75	.34	.86	1.63	.41	.83	1.55	.42	.80	1.52	.45	.77	1.53	.62	.66	
⅜ to 2½	Proportions	1	1.3	3.7	1	1.6	3.7	1	1.7	3.9	1	2.0	3.8	1	2.3	3.3	
	Quantities	1.72	.33	.95	1.58	.37	.87	1.51	.37	.87	1.49	.44	.84	1.50	.51	.74	
⅜ to 3	Proportions	1	1.2	3.8	1	1.6	3.9	1	1.7	4.0	1	1.9	4.0	1	2.2	3.5	
	Quantities	1.68	.30	.95	1.58	.37	.91	1.49	.37	.88	1.49	.42	.88	1.49	.48	.77	
½ to ¾	Proportions	1	1.5	2.3	1	1.9	2.2	1	2.1	2.2	1	2.3	2.1	1	2.8	1.3	
	Quantities	1.96	.44	.67	1.85	.52	.61	1.82	.56	.59	1.75	.59	.54	1.79	.75	.34	
½ to 1	Proportions	1	1.5	2.5	1	1.9	2.5	1	2.1	2.4	1	2.3	2.4	1	2.8	1.6	
	Quantities	1.90	.42	.70	1.77	.50	.66	1.72	.53	.61	1.67	.57	.59	1.72	.72	.41	

SIZES		FINE AGGREGATES, SCREEN OPENINGS PER INCH															
COARSE AGGREGATES Inches	Cement, in Barrels Aggregate in Cubic Yards	0-28			0-14			0-8			0-4			0-⅜ In.			
		Cement	Fine	Coarse	Cement	Fine	Coarse	Cement	Fine	Coarse	Cement	Fine	Coarse	Cement	Fine	Coarse	
½ to 1½	Proportions	1	1.4	2.8	1	1.9	2.9	1	2.1	2.9	1	2.2	2.8	1	2.7	2.1	
	Quantities	1.82	.37	.75	1.68	.47	.73	1.63	.51	.69	1.61	.52	.66	1.62	.65	.51	
½ to 2	Proportions	1	1.4	3.3	1	1.9	3.3	1	2.0	3.4	1	2.2	3.3	1	2.7	2.7	
	Quantities	1.75	.36	.86	1.63	.46	.79	1.55	.46	.78	1.52	.50	.74	1.53	.62	.62	
½ to 2½	Proportions	1	1.4	3.6	1	1.8	3.6	1	1.9	3.7	1	2.1	3.7	1	2.6	3.1	
	Quantities	1.72	.35	.91	1.58	.43	.85	1.51	.42	.83	1.49	.46	.81	1.50	.57	.69	
½ to 3	Proportions	1	1.3	3.7	1	1.8	3.8	1	1.8	3.9	1	2.1	4.0	1	2.4	3.3	
	Quantities	1.68	.33	.92	1.58	.42	.89	1.49	.40	.86	1.49	.46	.88	1.49	.53	.63	
¾ to 1	Proportions	1	1.7	2.4	1	2.1	2.4	1	2.4	2.1	1	2.6	2.2	1	3.1	1.5	
	Quantities	1.90	.48	.68	1.77	.55	.63	1.72	.61	.53	1.67	.64	.55	1.72	.79	.39	
¾ to 1½	Proportions	1	1.7	2.7	1	2.0	2.8	1	2.3	2.7	1	2.5	2.7	1	3.0	2.0	
	Quantities	1.82	.46	.73	1.79	.50	.70	1.63	.55	.65	1.61	.59	.64	1.62	.73	.48	
¾ to 2	Proportions	1	1.7	3.1	1	2.0	3.1	1	2.3	3.1	1	2.5	3.0	1	3.0	2.4	
	Quantities	1.75	.44	.80	1.63	.48	.75	1.55	.53	.72	1.52	.56	.67	1.53	.68	.55	
¾ to 2½	Proportions	1	1.7	3.3	1	2.0	3.5	1	2.3	3.4	1	2.4	3.4	1	2.9	2.8	
	Quantities	1.72	.43	.84	1.63	.47	.83	1.51	.52	.76	1.49	.53	.75	1.50	.64	.62	
¾ to 3	Proportions	1	1.7	3.5	1	2.0	3.7	1	2.3	3.7	1	2.4	3.6	1	2.8	3.1	
	Quantities	1.68	.43	.88	1.58	.47	.87	1.49	.51	.81	1.49	.53	.79	1.49	.62	.68	
1 to 1½	Proportions	1	1.7	2.8	1	2.0	2.9	1	2.3	2.7	1	2.6	2.6	1	3.1	2.0	
	Quantities	1.82	.46	.75	1.68	.50	.73	1.63	.55	.65	1.61	.62	.62	1.62	.75	.48	
1 to 2	Proportions	1	1.5	3.2	1	1.9	3.5	1	2.2	3.3	1	2.4	3.3	1	3.0	2.6	
	Quantities	1.75	.39	.83	1.63	.46	.85	1.58	.51	.76	1.52	.54	.74	1.53	.68	.59	
1 to 2½	Proportions	1	1.4	3.4	1	1.9	3.8	1	2.0	3.7	1	2.3	3.7	1	2.7	3.1	
	Quantities	1.72	.35	.86	1.58	.45	.89	1.51	.44	.83	1.49	.51	.81	1.50	.59	.69	
1 to 3	Proportions	1	1.3	3.6	1	1.8	4.0	1	2.0	3.9	1	2.2	3.9	1	2.7	3.3	
	Quantities	1.67	.33	.90	1.58	.42	.94	1.49	.44	.86	1.49	.48	.86	1.49	.59	.73	

Based upon laboratory investigations, using approved materials. Compressive strength, 28 days, with workable plasticity, 9 x 12 in. cylinders, 3,000 lb. per square inch.

In this instance the local aggregate, although fine and requiring more cement, will produce a yard of concrete at less cost. In general it will be found that the use of finer sand or of finer aggregate increases the amount of cement, the opposite being true for coarser sizes. Thus a coarse aggregate with all of the fine material removed, varying from 1 in. to 3 in. in size, combined with sand varying from ¼ in. down, uses 1.49 bbl. of cement; whereas an aggregate varying from 1 in. to ¾ in. combined with the same sand, ¼ in. down, requires 1.67 bbl. of cement for a cubic yard of concrete.

If the producer of aggregate materials can say what are the sizes of aggregates he can furnish, they can be used to make a concrete of a given strength. Should concrete of a strength other than 3,000 lb. per square inch be desired, then another table would be calculated with the proportions and quantities required accordingly; but the table given here is confined to the use of concrete for concrete roads where a better quality and greater strength are required than is necessary for concrete for many other structures.

Surveys for Flood Protection at Columbus, Ohio

Complete Topographical Map Based on Permanent Bench Marks—Four Miles of River Completely Surveyed

By R. C. Chaney

Construction Engineer, River Channel Improvement, Columbus, O.

SURVEYS were begun in the spring of 1917 for the preparation of the plans for the improvement of the channels of the Scioto and the Olentangy rivers for flood protection, through the City of Columbus, Ohio. The length of river selected for attention was approximately four miles; it extended from the confluence down to below the thickly settled portion of the low flood plain, and included most of the bank responsible for the disaster of 1913. The continuation of the protection up the Olentangy was contemplated as soon as the more urgent work was under way, and all plans were made with the idea of their fitting into the ultimate completed improvement, including, for instance, increased capacity —to be secured by further deepening—additional bridges, the improvement of the boulevards to be built early, and such parking and further development as might be determined upon. The development of an organization to handle the engineering, as a bureau of the City Engineer's Office, Henry Maetzel, city engineer, was begun Feb. 1, 1917, with the appointment of Mr. R. H. Simpson as engineer in charge, and the writer as principal assistant.

Locating and Leveling Circuit of Bench Marks

The need of a topographic map of the affected portion of the basin was at once apparent. Earlier studies of the problem had been based upon stadia maps, but for various reasons these were not available or were unsuitable, and it was determined to prepare a new map upon which to base studies for the channel improvement, and from which to work out the details of alignment and location. Accordingly parties were placed in the field engaged upon the establishment of a system of principal bench marks, some traverses for the location of certain levees and the triangulation network on which to hang the stadia survey.

A circuit about eight miles long, comprising a system of 36 principal or control bench marks, spaced from 1,000 to 1,500 ft. apart, and located along the border of the affected zone on both banks, was established. Most of these marks were brass plugs set in concrete monuments. The monuments were approximately 1 ft. in diameter and from 4 to 5 ft. deep, with the top formed and surfaced. A few plugs were set in conveniently located masonry. A reconnaissance trip spotted the locations. The party then, consisting of an assistant engineer, transitman and rodman, with the help of some prisoners borrowed from the city work house, and operating with a light Ford truck, placed the monuments.

Levels were run around the circuit, with a Buff & Buff hydrographer's level. This instrument was secured for such work and was a three screw Y-level with a micrometer attachment for slow movement in levelling, a mirror, and a bubble tube, sensitiveness of 6" per graduation. An iron pin with ring was used for a turning point. Great care was used in this work, by an experienced party, and excellent results were secured.

For the purpose of locating some two miles of existing levee, and tying in some principal streets, railway lines, etc., for early local plats, later to be made a part of the stadia map, closed traverses were run, totalling 10 miles in length. No extreme refinement was used in this work. Care was taken, however, to repeat all angles, to secure uniform tension of tape, to level the tape, to plumb over irregularities of ground, etc. A good field party on this work gave rapid and very satisfactory results. One traverse, with 14 angles and a length of measured line of 3¼ miles gave a closing error of 1:70,000. This work was done in cold weather.

The most interesting feature of the survey, however, was the trianguiar system and its use. This system consisted of a network of 120 stations, following the old banks of the river, and located for use as a foundation for the stadia work, and also to conform as nearly as practicable to the desired shape of figure for accuracy of observation and computation. Another use will be explained further on in this article. The bulk of the system, consisted of a series of quadrilaterals, but occasionally a triangle was unavoidable. At the extreme south end of the system triangles only were used. No attempt was made at reduction to sea level, nor was the true azimuth of lines determined. The extremes of elevation of stations were 700 and 745 ft. above sea level. For stations, sections of ¾ in. galvanized water pipe 30 in. long, wedge pointed, and capped, were used, except for a few cases where brass plugs were set in masonry. The stations were cut-stencilled for identification. The pipes were referenced by measurements to witness stakes, or otherwise, and driven slightly below the surface to be free from disturbance. The length of sides of figures varied from 205 ft. to 1,920 ft. The angle limits were 25° and 75°. However, a few exceptions to this rule were unavoidable.

Three base lines were used, the south one a little over 1,500 ft. long, the central one about 500 ft. long, and the north one, 1,900 ft. long. These were measured over lines of graduated stakes 25 ft. apart, with measured pull on a tape compared with the standard 100 ft. of the College of Civil Engineering, Ohio State University, with temperature and slope corrections. Three measurements were made of each base, means being used.

The field of observing the 590 angles was performed by a party of a work assistant engineer, a transitman

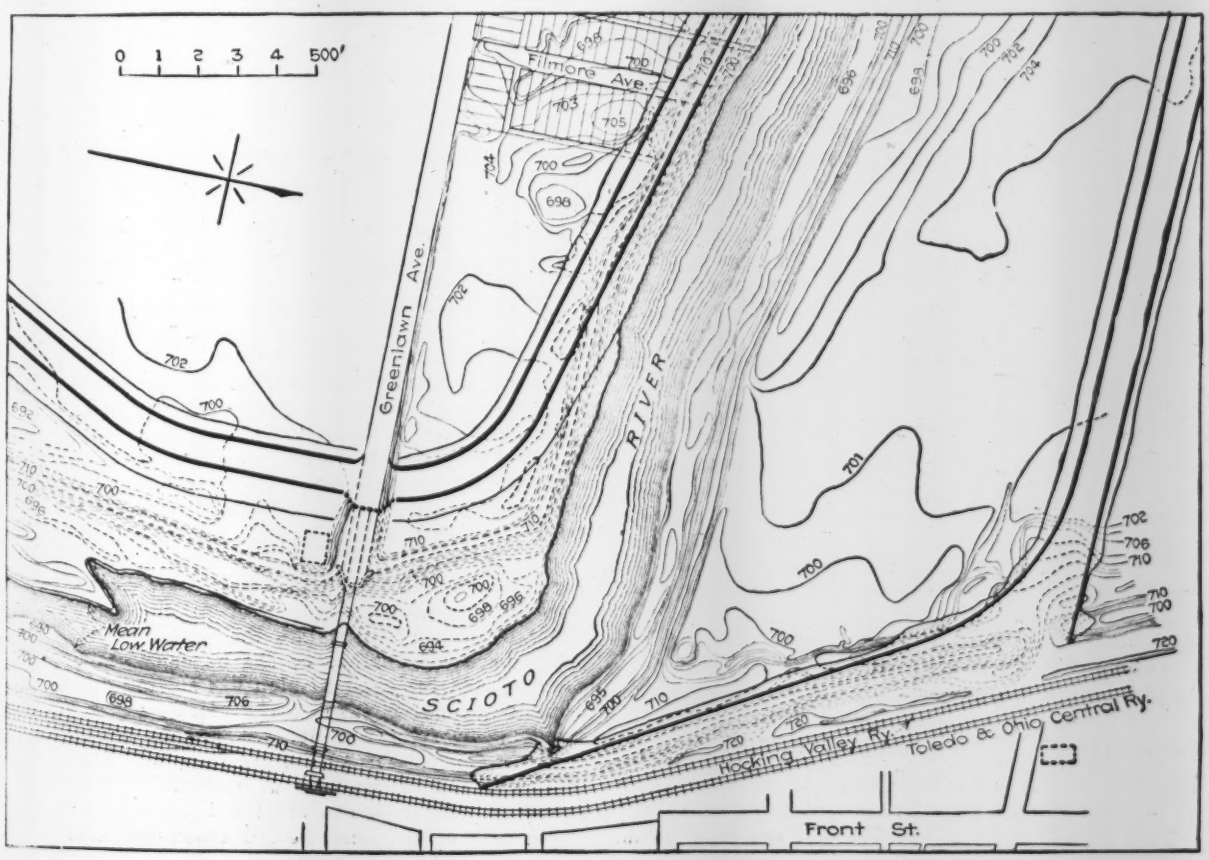
and three rodmen, using a Berger instrument No. 1, leading to minutes. Sights were taken, except in a few cases where a yellow pencil was entirely visible, to 10 in. square targets, plumbed over the stations. Angles were turned, doubled, tripled, etc., until a set of six values was secured, consistent within 15″. As the readings were recorded, the observer noted the increments for big irregularities as a guide for accepting the set, and when completed, a mean value was noted and the increments compared with this. A set with more than one bad increment, or whose increments varied over a range of more than 15″ from the mean, was discarded, or additional readings were taken. In any case, the mean of the variations of the increments from the mean value was a fair criterion of the value of the set of readings. When a figure was completed all triangles and the quadrilateral were closed as a final field check. When not closing within 15″ the bad angle was found and returned. All angles were turned by the same man, and careful work by him, and by the target men, gave very satisfactory results.

The observations were given to the reduction team, who checked the field test of angles, adjusted the values for closing the figures, and computed the lengths of the sides. The computer and checker worked with a vega table of seven-place logarithms. The adjustment of figures gave some trouble. An attempt at a "rational" method was based upon a principal of correction arrived at by assigning the angle a portion of the closing error obtained by weighing it with respect to its size-variation from 56°, taken as the ideal, and with respect to the consistency of the set of observations. This set of values, however, was rarely more nearly closing than the observed set. A second adjustment was then made, which was really little more than an arbitrary or forced closing. If this resulted in too great a departure from the field mean, the figure was repeated in the field. This was found to be the only cure for some adjustment cases. Most cases answered so satisfactorily to the adjustment process, that little time was wasted on bad ones, and they were immediately under suspicion upon developing any difficulty of adjustment. Only one third field observation was found necessary. The resulting angles were expressed in values to the second. Adjustment by least squares was not employed on account of the time required by the process.

The reduction was carried upstream from the south base to the central with 208 intervening angles. The computed and measured lengths of the central base differed by 0.038 ft.; of the north base, by 0.070 ft. This was entirely satisfactory and assured a dependable network from which both to map and carry out field location.

Following the reduction of the triangulation system, the stadia party using the network, rapidly covered the topography, locating levees, low water line, buildings, streets, roads, bridges, dams, railroads, etc., with little need for additional base line or traverse. There was nothing unusual in this work.

Upon the satisfactory closing of the triangulation the mapping was taken up. The calculation of the system had included the determination of co-ordinates of the system, referred to axes, of direction at 90°, but selected so that they parallelled the edges of the map. It was



CONTRACT DRAWINGS SHOW IN DETAIL PLAN OF PROPOSED CHANNEL

found that the entire length of rivers under study could be drawn to a scale of 1 in. = 100 ft. on a one piece map. This necessitated 62-in. paper 10 yd. in length, which, mounted on linen, was secured after some difficulty. The platting of the triangulation was done with great care, controlled within 6000-ft. zones, each station spotted by its coordinates, then the lengths of the triangulation sides scaled for check. It was practicable to get a consistency to within 1 ft. for all points.

The platting of the stadia work was carried on behind that of the triangulation system, a drawing table 64 in. wide by 14 ft. long permitting a number of draftsmen to work simultaneously. The map was completed by the drawing in of 1-ft. contours and all topographical features of interest, including sewers, railroads, property lines, traverses, etc.

The paper location of the flood protection works was a simple matter now, and the levee lines were worked out completely with coordinates of points of curves and tangents. The field location was then simply a matter of traversing from triangulation points, and the running in of the levee centerlines, and the adjustment. The control for these lines was then established by placing concrete monuments on radial lines from ends of curves and other points with reference distances and angles of permanent sights. In the mapping of the topography, water colors were used, red for surveys, brown for contours, blue for water, green for sewers, and black for other features. The system of co-ordinates provided excellent means of location for any point of the proposed work, or relocation of features of the original topography after or during the progress of the construction.

The contract drawings, 24 by 36 in. in size, were based upon the map. All topography was traced direct from it. The folio for the principal contract, that for the channel excavation and embankment, included first, an index sheet, or general plan, followed by map sheets with match lines, taken from the big map, showing in more detail the plan of the proposed channel. After these came such details as channel sections, etc. The index map was to the scale of 1 in. to 400 ft., and gave a comprehensive view of the improvement as a whole, with locations of levees and other improvements, and quantities of excavation and embankment by sections for the purpose of showing local balance of cut and fill. It contained also a statement of the estimated quantities, some 44 items.

The map sheets of this folio contained little in addition to the information shown by the large map. Field folios of these sheets provided all data for location parties, and were used printed on cloth for general field work. For greater convenience these drawings were photo-reduced in the ratio 1:5 and bound in pocket books. This was particularly convenient in the case of the contracts for the structures, such as bridges, levee walls, sewers, dam, etc. The large map constituted a permanent record of the original situation, with the improvement of the rivers shown in true relation.

Concrete Mixture Was 1 : 1½ : 3

In Table 1, on page 811 of *Engineering News-Record*, April 22, 1920, the proportions of the concretes made by G. M. Williams were 1 : 1½ : 3, not 1 : ½ : 3 as the dropped type in some of the issues of the paper made the caption to the table read.

Timely Treatment for Saving Wood Block Pavements

By John Stanley Crandell
Consulting Engineer, General Tarvia Dept., The Barrett Co., New York City

THE problem that many of the city engineers have to solve today is "How can my wood block pavements be saved?" If taken in time, the solution is simple. If maintenance is delayed, total dissolution of the pavement may be looked for with certainty.

Let us assume a case: The pavement is in a southern city; laid two years ago; supervision poor, with consequent skimping of cement in concrete base, sand cushion of irregular depth, sand filled joints, and

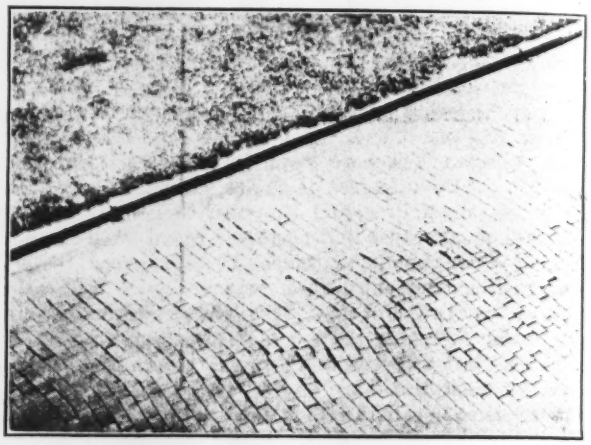


FIG. 1. OPEN JOINTS IN WOOD BLOCK IN PENSACOLA, FLA.

good blocks badly laid. At present all the joints are only partially filled with sand, and many of them are so empty that the blocks can be lifted out with the fingers. When it rains the pavement swells so that hummocks and ridges appear; as vehicles pass by, muddy water is forced out of the open joints, and descends in a spray over the clothes of unfortunate pedestrians; if the rain is intense, the entire pavement may float away. Sometimes, in damp weather, large areas bulge and swell so that travel is unsafe. During dry spells the blocks shrink, become loose and rattle as traffic passes over them; the loose blocks begin to check and split, and finally splinter into match wood.

Even in such a bad case the pavement can be made reasonably good at clight expense if it is repaired *in time*. First, examine carefully the entire area, to determine, if possible, where any cracks may exist in the concrete base. Where a crack is suspected, remove some of the blocks and see if the crack is beneath. If it is, take up the blocks above it, and, after cleaning out the crack, fill it with hot coal tar pitch. Make sure that no water will be able to find its way up through the foundation into the sand cushion. Second, where the surface of the pavement is uneven, showing that the sand cushion has shifted due to the presence of water, take up the blocks, strike off the cushion, and relay the blocks, replacing broken ones with new ones. Try to get the same size blocks for renewals. Third, replace all shattered blocks with new ones, taking care to bed them properly. Fourth, sweep filth out of joints, or, if sweeping fails, flush the joints with a fire hose of sufficient pressure to

tear loose the filth. Fifth, let the pavement dry thoroughly. Sixth, apply a coat of light coal tar, using about one gal per square yard, or more if the pavement will absorb it. This should be applied hot, and should be swept into the joints with push brooms or squeegees. Seventh, keep traffic off until the next day, and before traffic is admitted sand the pavement well with clean, hot sand. It may be necessary to repeat this treatment using a lesser amount of tar. In most cases one application is sufficient. The tar should conform to the following specifications:

(1) The specific gravity shall be not less than 1.20 or more than 1.26 at 60 deg. F.

(2) The viscosity tested by the standard Engler Viscosimeter, shall be not less than 125 sec., nor more than 200 sec. for 100 c.c. at 212 deg. F.

(3) On distilling 100 c.c. of the material, no distillate shall come over below 338 deg. F.: on continuing the distillation to 572 deg. F. not more than 25 per cent of distillate shall come over. The specific gravity of the entire distillate shall not be less than 1.03 at 60 deg. F. The residue from the foregoing distillation shall have a melting point not greater than 165 deg. F.

(4) The free carbon shall be not less than 12 per cent nor more than 22 per cent.

Light Tar Better Than Pitch

It may be asked "Why not use paving pitch instead of a light tar to fill the joints?" The answer is that in a pavement such as we have considered here, the joints are, to a large extent, partly filled with sand and dirt, and a considerable yardage will be found where the joints are full to the top before the tar is applied. Further, not only are the joints to be made waterproof but the blocks themselves must be waterproofed as well, and a light hot tar will do this work better than a heavy paving pitch. Again, the light tar will form a mastic with the sand in the joints, whereas paving pitch will not be so likely to. If water can be kept out of the sand cushion the pavement will usually give good service.

Now, let us assume another case. The pavement is in a northern city—foundation fair; cement-sand cushion, fair; pitch filler had been used, but joints were not well filled; the blocks were supposed to have a 16-lb. treatment, but in reality it was an 8-lb. treatment; blocks have dried out, are loose in dry weather, and swell and cause bulges in wet weather. Here the treatment is simplicity itself, and the results will be successful if the treatment is given *in time*. First, clean the pavement thoroughly, flushing with water if necessary. Second, examine the blocks carefully, replacing any that show signs of rotting or of splintering. Third, when the pavement is dry, and on a warm, sunshiny day, apply a coat of light tar such as is used for cold surface treatments of macadam, using about ½ gal. per square yard, or more if the blocks will absorb it. This tar should pass these specifications:

(1) The specific gravity shall be not less than 1.14 nor more than 1.18 at 60 deg. F.

(2) The viscosity tested by the Engler Viscosimeter, shall be not less than 100 sec. nor more than 250 sec. for 100 c.c. at 104 deg. F.

(3) On distilling 100 c.c. of the material to 338 deg. F. not more than 7 per cent shall distill over On continuing the distillation to 572 deg. F. the residue shall be not less than 65 g. This residue shall be a soft pitch at 60 deg. F. If the residue appears hard, it shall be tested for melting point and the melting point shall not exceed 140 deg. F. by the half-cube method in water. The specific gravity of the entire distillate shall be not less than 1.01 at 60 deg. F.

(4) The free carbon shall be not less than 4 per cent nor more than 12 per cent.

Fourth, keep traffic off until the pavement shows no further signs of absorbing the tar, after which cover with clean sand.

From time to time sand must be strewn over these surface treatments if they show signs of becoming unduly sticky. A mat coat is thus built up that protects the blocks from wear for a time, while keeping surface water from entering the pavement.

Before attempting to cure a wood block pavement's ills by surface treating the blocks, the engineer should

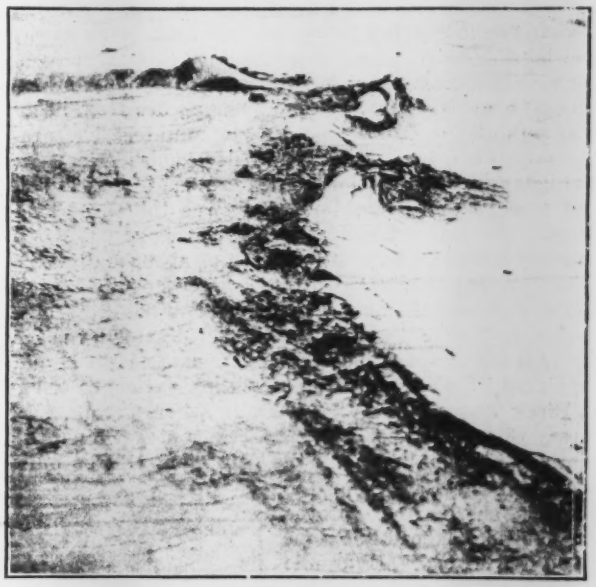


FIG. 2. SWELLING OF WOOD BLOCK CAUSES ASPHALT SURFACE FAILURE—NEW YORK CITY

make sure that the trouble is not caused by sub-surface water finding its way up through the concrete base, or through cracks or expansion joints. In many cases the sand cushion is always wet from this cause. If the blocks have not been given a thorough treatment with creosote oil before they are laid they will rot from the bottom up to the top. This decay cannot be detected for some time, but suddenly the pavement fails and it is discovered that many of the supposedly sound blocks are, in reality, mere shells. To give such a pavement a surface treatment would be a waste of money, and would discredit surface treatments.

If sand is used liberally as a cover, there will be no objections forthcoming from the public about smeary streets that exude tar. Pea gravel or good quality stone chips may be used in place of sand.

It must be kept in mind that surface treatments are really maintenance work and must be renewed from time to time. How long they will last is not known. There is a street in Milwaukee treated four years ago that is in excellent condition today. The wood block pavements in Memphis, Tenn., and other cities have been treated satisfactorily. But after awhile re-treatments are necessary.

In every case the engineer should "do it now," because there is no other paving material that goes so quickly as wood block when it begins to fail. Ten cents' worth of tar may save a yard of pavement that cost $3, if applied when it is needed.

Plan Piers of Record Length for Terminal at New York

Lehigh Valley Railroad Starts Building First Unit of Three Piers, Each Seven Thousand Feet Long—To Carry Extensive Trackage—First Wharf Will Have Ore and General Freight-Handling Facilities

CONSTRUCTION of the first unit of a new rail and deep-water terminal to have three piers each seven thousand feet long carrying extensive trackage, warehouse and freight handling facilities has been started by the Lehigh Valley Railroad Co. at the tide flats in the Greenville section of Jersey City on New York Harbor. The first unit of the terminal, for which a 35-ft. channel is now being dredged out to deep water, will be a 3,000-ft. wharf near the foot of Chapel Ave., Jersey City, providing facilities for the handling of general heavy freight and for unloading ore from boats into cars at the rate of one car per minute. The preliminary plan for the ultimate development includes storage and classification yards, an engine terminal, and a large grain elevator, as well as the three long piers. The entire terminal will cover about 635 acres and will provide a total dock length of about six miles.

The present New York Harbor facilities of the Lehigh Valley R.R. and the new Claremont Terminal are shown in Fig. 1. The first unit of the new terminal will replace the railroad company's ore pier at Constable Hook, and supplement the company's piers at the "National Docks" at Black Tom, and the Tide Water Basin Terminal in Jersey City. At the site of the Claremont Terminal the shore is tide flat land and the new piers will be built out approximately from the present shore line to the established bulkhead line some 5,000 ft. beyond. Hydraulic filling from channel dredging is being employed to build up land for the yards and approaches, as in the case of the Greenville terminal yard of the Pennsylvania R.R. adjacent to the new Claremont Terminal at the south. Fig. 1 approximately indicates the extent of hydraulic filling and dredging that will be necessary. Following the construction of the first unit, it is planned to extend the piers to the pierhead line indicated as "approved by Assistant Secretary of War, Oct. 30, 1915." This extension, together with the dredging of slips to extend 3,000 ft. inland from the government bulkhead line, will give a total pier length of about 7,000 ft. The piers will carry large warehouses, open dock and storage space and will be fully equipped with traveling revolving gantry cranes and other mechanical freight-handling machinery. To provide the necessary car service for these facilities, extending such a long distance from main yards, extensive trackage for storage and for some classification will be carried out on the piers, as indicated in Fig. 2, in order to insure an adequate car supply so that loading or unloading at any portion of the piers will not be subject to interruption. A pier width of about 400 ft. is provided to carry sufficient trackage for these purposes, together with warehouse and open dock space, and at the same time will afford greater rigidity of construction. The slips between the piers are designed with a clear width between piers at the pier head line of 550 ft., tapering to 450 ft. at the inshore end of slip. This special feature of opening up the width, at the entrance from the approach channel, is expected to facilitate the easy and rapid passage of steamers and docking at piers, allowing ample fairway for passage in the slips when steamers of maximum beam are moored opposite each other along sides of each pier.

The first unit now being built comprises approximately the first half of pier 1 (Fig. 2) extending from the bulkhead to be established by the railroad company about 3,000 ft. to a point just beyond the bulkhead line established by the War Department and the State of New Jersey. Thus, almost the entire length of the south side of this first wharf unit will be filled in prac-

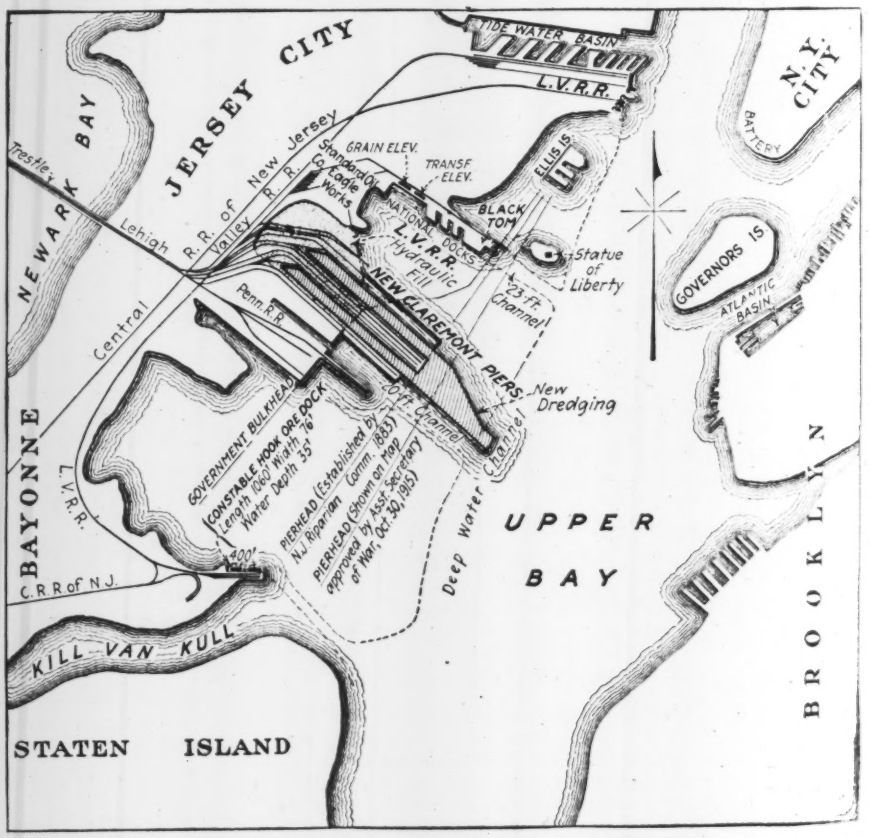


FIG. 1. WATER-FRONT FACILITIES OF LEHIGH VALLEY RAILROAD IN NEW YORK HARBOR TO BE ENLARGED BY NEW CLAREMONT PIERS

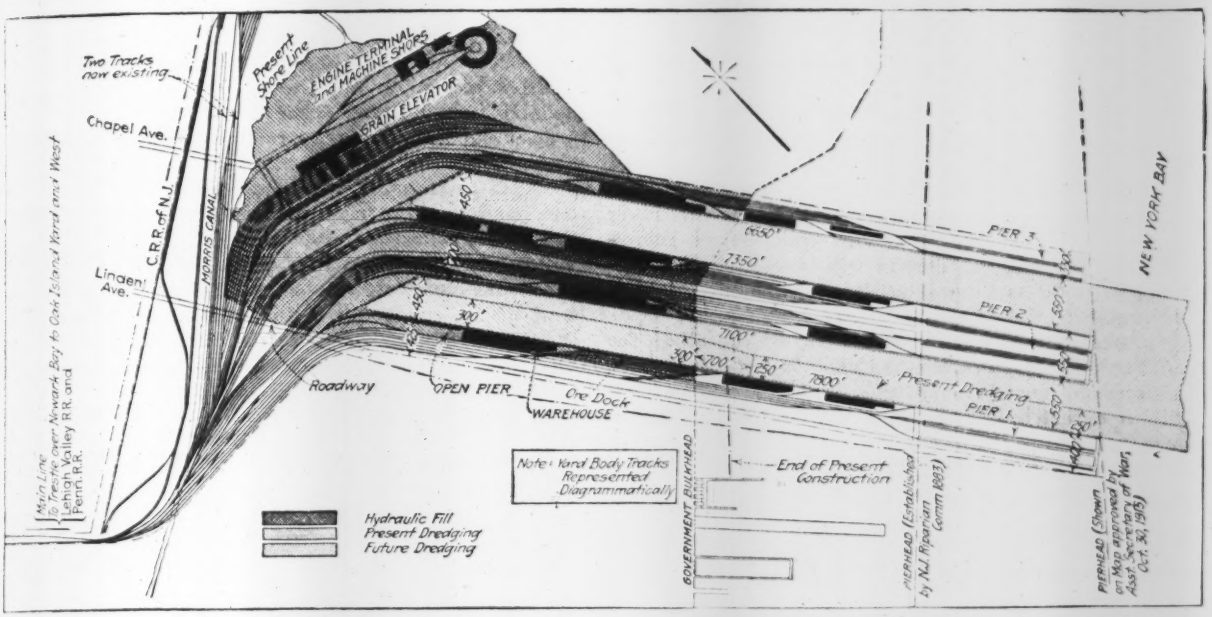


FIG. 2. RAIL AND DEEP-WATER TERMINAL TO HAVE THREE PIERS OVER SEVEN THOUSAND FEET LONG

tically level with the Pennsylvania R.R. property to the south. Wooden sheet piling will be driven for the entire length of the wharf and 40 ft. from the dock line, to retain the hydraulic fill, and tracks south of this line will be carried on solid fill. The channel now being dredged extends along the north side of the wharf site, 300 ft. wide to the Government bulkhead line, from which it tapers to 250 ft., extending out to deep water about 7,000 ft. from this line. When pier 2 is constructed this channel will be widened between the two piers to a maximum of 550 ft. The dredging which will be necessary for the entire project as ultimately planned will amount to about 12,000,000 cu.yd. Dredging for the present slip will require the removal of 3,600,000 cu.yd. A large portion of the hydraulic fill from dredging will be required in building up to the necessary elevations for gravity yard rises, some of which will be about 35 ft. above mean low water.

The track layout for the portion of the first pier now being constructed is indicated in Fig. 3. This unit will comprise an open pier dock 720 ft. long carrying four tracks and open storage space served by a gantry crane, a concrete and steel warehouse 816 ft. long and 100 ft. wide, and farther outshore an ore dock 1,068 ft. long equipped with four unloaders. From the end of the ore dock a pile trestle will be built out about 700 ft. to carry the drill track for pulling out strings of loaded ore cars and delivering them to loaded tracks connected with the main running track. Two 600-ft., 20,000-ton boats may be docked at one time at the ore unloaders; two boats at the warehouse dock, and one at the open dock.

While the yard and pier layout will afford some opportunity for the classification of freight, it is the general plan of operation that classification shall be done at the Oak Island yard of the Lehigh Valley R.R., between Newark Bay and the City of Newark. Trains of loaded ore cars will be run out from the dock over the Newark Bay trestle to the Oak Island yard. The ore-handling facilities will be used principally by the Bethlehem Steel Co. in connection with the movement of ore from steamers from Cuba and the West Coast of South America to the plant at Bethlehem, Pa.

The dock will be equipped with two 15-ton Hulett electric ore unloaders, of the bucket and boom type, for unloading from ore carrying boats of typical sections. They will load into cars under the machine. The

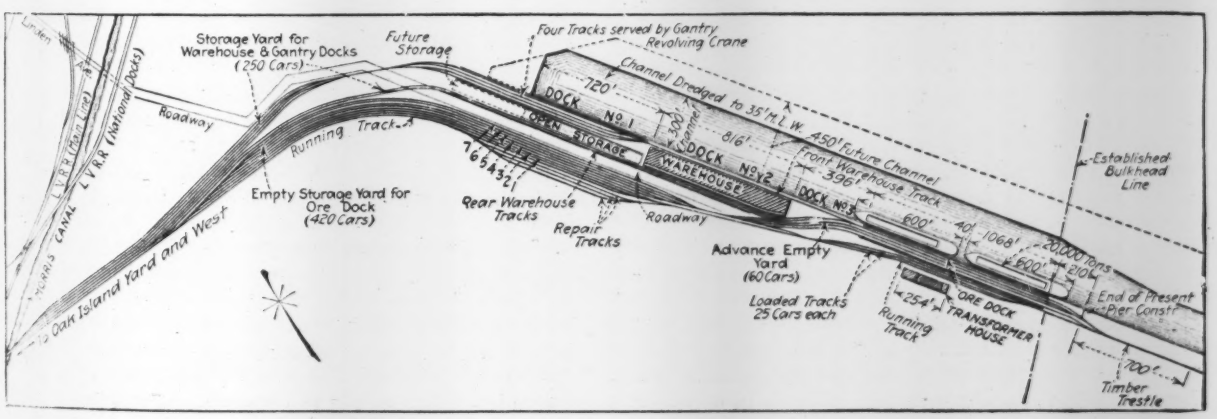


FIG. 3. TRACK LAYOUT OF FIRST PIER UNIT—ORE-UNLOADING WAREHOUSE AND GANTRY DOCKS

capacity of each "larry" or traveling overhead hopper (30 tons) is such that two trips will fill an ordinary car. The larry car runway will extend to the rear a sufficient distance to permit loading ore in cars on the track at the rear of the back leg if so desired. The maximum capacity of each machine when unloading boats so designed as to allow the bucket to fill itself will be about 500 tons per hour. In addition to the two Hulett machines there will be two rope system ore unloading towers, portal type, equipped with grab buckets having a capacity of 5 tons. Towers will be electrically operated, with 30-ton traveling larries, mounted in the framework of the unloading towers.

To insure the desired flexibility of operation for rapid unloading of ore, it was thought necessary to provide storage space for empties with a capacity of over 400 cars, connecting as near as possible with the ore-loading tracks on the dock under the loaders. For this purpose a large portion of the empty storage gravity yard is located beyond the bulkhead line established by the railroad company, as shown in Fig. 3, to bring the storage tracks as near as possible to the loaders. These tracks have a storage capacity of over 420 cars part of which are on a grade of 0.7 per cent. Strings of about ten to fifteen cars will be delivered by a steam drill engine from this yard to the advance empty tracks which have a capacity of 60 cars and connect with the ore-loading tracks. To avoid hampering the operation of the overhead ore unloaders, electric locomotives operating on narrow-gage tracks, between loading tracks 1 and 2, and 3 and 4, will be used to move strings of cars from the advance empty tracks, and spot them under the larries on the ore dock by means of poling arms with adjustable clearances. From the approach to the ore dock cars will be handled by the electric locomotives to the east end of the dock where strings of ten loaded cars each will be delivered to a steam locomotive operating over the drill track carried by the timber trestle. The loaded cars will be pulled out on the trestle and then pushed into the two loaded tracks south of the unloaders. It is planned to unload ore and handle outgoing loaded ore trains at the rate of one car a minute with the four unloaders operating simultaneously.

At the start of unloading operations, storage yard tracks 1 to 7 and the advance empty yard will be filled with empties. First, cars from tracks 1 and 2 will be delivered in strings of about fifteen to the empty advance yard, so that these two tracks may be made available (as unloading progresses) for either running or loaded storage, as might be required in case of delay in pulling out loaded trains or other emergency. For this purpose, tracks 1 and 2, together with the running track, have a ladder track at the east end separate from that serving storage tracks 3 to 7. The steam locomotive operating on the timber trestle at the end of the pier will deliver loaded cars to the two tracks which lie between the ore loading tracks and the running track. Each of these loaded tracks has a capacity of 25 cars, which will be pulled out westward by a drill engine operating on the running track, consolidated into a 50-car train. The loaded train will then be pulled out to the Oak Island yard, or into the advance loaded yard which will be located between the extreme west end of the project and Newark Bay, parallel to the main line on the north side. Approaching this yard, crossovers will be provided to transfer outbound loaded ore trains from left hand track to right hand main line track and to the advance loaded yard. Since these trains will be pulled out of the running track only at intervals of about one hour, it will be possible to use this track, west of the connection with the west ladder track of the empty storage yard, to deliver trains of empties into the yard, so that a large supply of empties may be continuously maintained to serve the ore loading tracks. In this way, both empty and loaded cars may be handled in and out of the dock, each at the rate of about one car per minute.

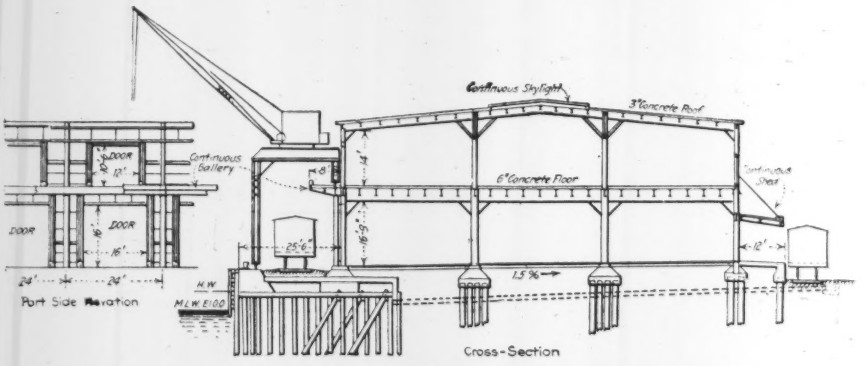


FIG. 4. TYPICAL CROSS-SECTION OF WAREHOUSE—PRELIMINARY DRAWING

As indicated in Fig. 3, the open pier and warehouse docks are connected with a receiving and storage yard having a capacity of 250 cars. The four tracks on the open pier and the open storage space will be served by an electrically operated traveling gantry crane of the portal type, supporting a traveling revolving crane of 30 tons capacity. The rear gantry track will be used as a running track for the front warehouse track. Two rear warehouse tracks which can serve alternately as running tracks are provided. As shown in the drawing, a roadway, consisting of an extension of Linden Ave., Jersey City, is to lie between the outshore portion of the empty storage yard for the ore dock and these two tracks, so that one could be used as a team track. The connections between the ore dock loading tracks and the front and rear warehouse tracks are to be used only in cases of emergency where greater flexibility of operation is desirable.

The warehouse is being planned to provide for both storage and classification of import and export freight. A preliminary cross-section drawing, together with a section of the side elevation, is shown in Fig. 4. On the north side of the warehouse, adjacent to the slip, a revolving crane mounted on a traveling portal gantry will load and unload from ship to cars on the front track or the upper or lower floors of the warehouse. Inside the warehouse freight will be transported by electric trucks and elevators will transfer trucks from one floor to another. A loading platform for the rear track will extend the entire length of the shed. It is thought that

this arrangement will insure a high degree of flexibility in operation. Freight may be received or discharged from cars on either track into and out of the warehouse; received or discharged from cars on front track to or from boat, and received or discharged from either floor platform of warehouse to or from boats and cars.

Dredging for the first slip has now been in progress for about four weeks and approximately 10,000 cu.yd. of material are being pumped inshore from the channel daily. The Gahagan Co. of Brooklyn, N. Y., has the contract for the dredging operations. Construction of the terminal is being carried out under the direction of George T. Hand, chief engineer. Plans are being prepared under the direction of J. J. McCleece, architect, and the construction work in the field is under the supervision of W. R. Johnston, terminal engineer. The bulkheading of the wharves will be built by Henry Steers, Inc., New York. The ore-handling equipment is to be furnished by the Wellman-Seaver-Morgan Co., Cleveland, and the Mead-Morrison Mfg. Co., East Boston.

Effect of Calcium Chloride on Steel

TESTS made by the United States Bureau of Standards and noted in the report of the Director for the fiscal year 1918-1919 indicates a corrosive action of calcium chloride on steel in concrete. Plain and galvanized wire mesh imbedded in slabs of river sand mortar gaged with plain water and with a 4 per cent solution of calcium chloride showed at the end of two years that the corrosive effect of the salt was very marked. Plain wire mesh imbedded in 1:3 mortar was attacked the most, being completely eaten through in places. Galvanized metal was attacked seriously, although not as badly as plain mesh. Metal imbedded in 1:2 mortar was not so badly attacked as that imbedded in 1:3 mortar. In all cases of metal, both plain and galvanized, imbedded in mortar, gaged with plain water, the reinforcement was in excellent condition; it was not rusted, which demonstrated the protection afforded by the portland cement. A comparison of the condition of the reinforcement imbedded for two years and that imbedded for one year showed the rusting due to calcium chloride was progressive, and becomes worse with age. Reinforcing rods imbedded in 1:2:4 and 1:1½:3 concrete, made with and without calcium chloride, also showed a corrosion due to calcium chloride, but to a somewhat lesser extent.

Available Federal-Aid Funds

MORE than $117,000,000 is still available to states for Federal-aid highway construction. Most of the money cannot be used prior to June 30, 1920, though approximately $35,000,000 of the apportionment for the fiscal year ending on that date is still available. Two states only have failed to use all Federal-aid money apportioned to the various states during the fiscal years 1917, 1918 and 1919. They are Alabama and Kentucky, the latter state still having more than $250,000 unused from those years. Texas has the greatest apportionment —$10,706,238.65, with New York a close second. One-third of the states have used all funds available until the 1920 fiscal year.

The status of Federal-aid funds as of March 31, 1920, based on projects approved as reported by district engineers is given herewith:

STATUS OF FEDERAL AID FUNDS ON MARCH, 31, 1920, BASED ON PROJECTS APPROVED AS REPORTED BY THE DISTRICT ENGINEERS.

State	Balance Available from Apportionment for fiscal years 1917-18-19	Balance Available from Apportionment for fiscal year 1920.	Balance Available from Apportionment for fiscal year 1921.*	Total Apportionment Available
Alabama	$ 72,604.11	$1,995,501.80	$2,104,883.51	$4,172,989.42
Arizona		810,213.98	1,373,644.16	2,183,858.14
Arkansas		1,156,091.78	1,685,178.09	2,841,269.87
California		322,593.64	3,054,675.51	3,377,269.15
Colorado		1,596,537.28	1,755,759.17	3,352,296.45
Connecticut		137,547.22	613,349.43	750,896.65
Delaware		17,290.62	162,674.81	179,965.43
Florida		602,816.41	1,147,447.92	1,750,264.33
Georgia			2,564,693.45	2,564,693.45
Idaho			1,027,253.64	1,027,253.64
Illinois			2,505,801.86	2,505,801.86
Indiana			16,602.40	16,602.40
Iowa			279,240.11	279,240.11
Kansas			1,957,843.36	1,957,843.36
Kentucky	253,954.53	1,856,043.83	1,951,755.43	4,061,753.79
Louisiana		47,966.58	1,362,231.13	1,410,197.71
Maine			750,671.21	750,671.21
Maryland			465,990.18	465,990.18
Massachusetts		925,017.95	1,472,788.83	2,397,806.78
Michigan		930,752.58	2,891,667.97	3,822,420.55
Minnesota			1,708,409.62	1,708,409.62
Mississippi		1,307,227.29	1,807,557.17	3,114,784.46
Missouri		796,972.05	3,387,899.60	4,184,871.65
Montana		1,558,098.79	2,006,990.13	3,565,088.92
Nebraska			1,085,814.61	1,085,814.61
Nevada		1,152,498.10	1,276,344.43	2,428,842.53
New Hampshire		19,054.70	414,838.93	433,893.63
New Jersey			272,119.17	272,119.17
New Mexico		721,462.67	1,598,467.85	2,319,930.52
New York		4,485,582.52	4,971,893.11	9,457,475.63
North Carolina			289,124.78	289,124.78
North Dakota		609,355.70	1,536,227.80	2,145,583.50
Ohio		731,797.54	3,706,246.81	4,438,044.35
Oklahoma		1,058,599.50	2,302,478.33	3,361,077.83
Oregon		67,027.10	1,576,152.03	1,643,179.13
Pennsylvania			4,467,785.17	4,467,785.17
Rhode Island		133,074.47	233,256.87	366,331.34
South Carolina		844,009.66	1,436,019.04	2,280,028.70
South Dakota		362,200.99	1,615,779.44	1,977,980.43
Tennessee		2,069,075.33	2,261,913.90	4,330,989.23
Texas		4,844,640.19	5,861,598.46	10,706,238.65
Utah			320,530.94	320,530.94
Vermont		359,304.11	450,077.09	809,381.20
Virginia		1,146,248.18	1,977,673.83	3,123,922.01
Washington			909,812.72	909,812.72
West Virginia			856,999.53	856,999.53
Wisconsin		2,341,489.24	2,544,945.35	4,886,434.59
Wyoming		674,153.97	1,233,715.84	1,907,869.81
Totals	$326,558.64	$35,680,245.77	$81,254,824.72	$117,261,629.13

*Funds shown in this column cannot be used prior to June 30, 1920.

Sewage Siphon Designed in Spite of Meager Reference Data

Isolated Disposal Plant Enabled To Operate by Improvising Timing Mechanism—Full Calculations Given

By G. H. Bayles
Recently on Engineering Work in Chile

Sometimes the engineer in an isolated place finds himself puzzled to make even what would be a simple design if he had available all the possible sources of information. A case in point was the design of an automatic timed siphon for a sewage-disposal plant, described below. Ten-inch timed siphons had been ordered, but an unusual and unavoidable delay in their delivery would have tied up the job unless some substitute could be made. The engineer found nothing in the available books that gave any details of such design, so, from a general sketch in a book on sewage disposal, he studied out the principle and made the design.

The foundry on the job was too busy to undertake large castings, and the pattern-making at the time would have caused almost as much delay as waiting for the delivery of the order. It was necessary, therefore, to use such pipe as were available and as little shopwork as possible. These considerations influenced the using of 9-in. pipe and boiler-plate bells. The job was located at an elevation of nearly 9,000 ft. above sea level, which also influenced the design and modified the dimensions of all parts.

Nothing new or unusual is clamied by the author for this design, but the details of the principles involved are not given in the handbooks or in current literature, and a statement of them here with an example worked out in full may sometime prove convenient to other engineers.—Editor.

The following terms adapted from the description given by the Pacific Flush Tank Co. of the Miller automatic timed siphon, will be used in the explanation:

Main Trap—The combination of 9-in. pipes and elbows set in concrete, the long leg of which extends above the main floor of the siphon chamber, the short leg being connected to the discharge pipe from the contact beds.

Blow-off Trap.—Two-inch pipe which is screwed into the short leg of the main trap and having one end extending above the water line in the chamber, the other extending up under the bell.

Bell—The plate-iron drum which is placed over the long leg of the main trap and which is supported by angle-iron legs.

Harding Vent—Two-inch piping attached to the side and near the top of the bell.

Starting Bell—Nine-inch pipe and flanges bell suspended in the timing chamber by piping leading to the blow-off trap.

Draining Siphon—Two-inch piping leading from the long leg of the main trap, passing through the wall between the main siphon chamber and timing chamber and extending down into the tile well located in the latter.

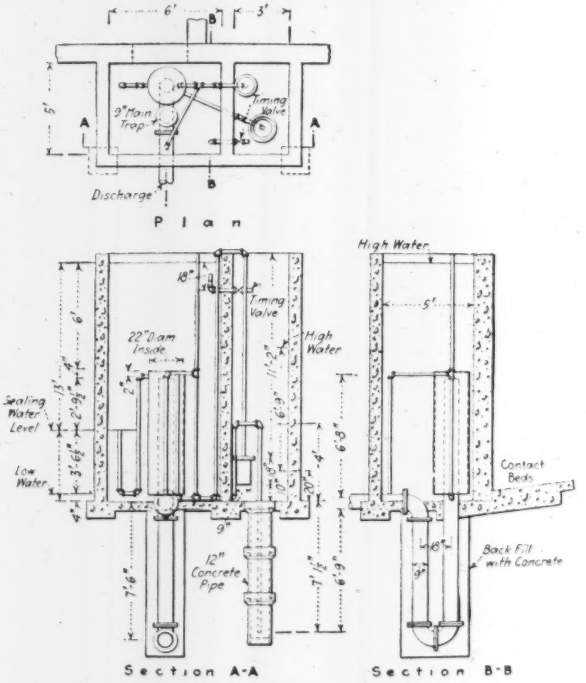
Timing Valve—Valve on piping connecting main siphon chamber and timing chamber.

Main Siphon Chamber—Chamber in which the main siphon is located and having an opening at the bottom into the contact bed.

Timing Chamber—Chamber containing starting bell, draining siphon and timing valve.

The height of the bell was taken arbitrarily as a little more than half the depth of the siphon chamber, in order to simplify the general dimensions. The principle of the design is then as follows: The short leg of the main siphon, the outside leg of the blow-off trap and the tile well in the timing chamber must all be a little longer than the distance from the final water level inside the bell to the high-water level in the main siphon chamber.

The short leg of the Harding vent must be of such length that the egress of air from the bell is cut off at a point where a sufficient quantity of air is retained in the bell and connected piping to balance the additional head of water above the main trap without permitting the water to overflow into the main trap. The size of the starting bell must be such that when the air inclosed in it and the pipe leading from it to the blow-off



SIPHON HAD TO BE BUILT OF AVAILABLE PIPE AND WITH LITTLE SHOPWORK

trap has sufficient compression to start the siphon some space occupied by air will still remain inside this bell. The height of the inverted U of the draining siphon must be such that the rise of water in the timing chamber will not citate sufficient pressure to overcome the pressure from the main siphon and put the draining siphon into operation before the main siphon is started.

The size of the pipe extending up under the bell and forming part of the blow-off trap must be such that it will contain sufficient water to make it certain that the other leg of the blow-off trap and the pipe leading to the starting bell are both filled to the overflow point before the water in the main siphon chamber reaches the maximum elevation. The pipe leading from the main siphon chamber into the timing chamber, and on which is placed the timing valve, must be of sufficient size to allow the timing chamber to be filled in the minimum time necessary for the sewage to remain in the contact bed. The size of the pipe for the draining siphon should be such that the timing chamber will be emptied a little

after the contact bed is emptied. This size is easily determined by comparing the rate of flow through the draining siphon and the quantity of water to be handled with the rate of flow through the main trap and the quantity of water that has to pass through it.

It was found that a 9-in. main trap would empty the contact bed in less than 10 min., and as pipe of this size was available and the speed of operation was considered satisfactory, 9 in. was adopted as the diameter of the main trap. No fine calculation was made before the diameter of the bell for the distance from the top of the main trap to the inside of the top of the bell, but a diameter of 22 in. and a height of 4 in. above the main trap were found to be sufficient for easy flow, and such dimensions were therefore adopted. A 2-in. pipe was found to be of sufficient size for the draining siphon as well as for the pipe connecting the two chambers. All other small piping was arbitrarily made of the same size in order to simplify the pipefitter's work, except the portion of the blow-off trap extending up under the bell, which was found to require a 3-in. pipe so as to have sufficient water remaining in this trap to cause proper operation of the device.

By reference to the figure, it will be seen that the maximum water elevation in the main siphon chamber is 6 ft. 4 in. above the top of the main trap, and an elevation of 2 in. below the top of the main trap was assumed for the maximum height of the water inside of the bell. The distance then from the invert of the main trap to the top of the opening at the bottom of the U is taken as 6 ft. 9 in., which leaves a 3-in. water seal in the main trap. The height of the water column in the blow-off trap is made 6 ft. 8 in., which leaves a 2-in. water seal in this trap but which, in case of water rising above the calculated elevation in the main siphon chamber, will cause this trap to discharge before the main trap.

In case the main siphon chamber is not filled to the assumed elevation, it was thought best to raise the top of the inverted U of the drainage siphon sufficiently to cause the starting bell to operate in any case. For this reason the U of this siphon is somewhat longer than necessary for ideal operation. The length of the leg of the draining siphon extending into the tile well is made such that the pressure due to the rise of water in the main siphon chamber will not cause the air to blow out through this pipe. A little more than 6 ft. 9 in. is required, and the depth was made 7 ft. 1½ in. in case there should be some suction on this line after the timing chamber is emptied to the floor level, and the water level lowered somewhat into the tile well.

The measurements and calculations for the siphon are, then, as follows:

Main Siphon	Diameter inches	Area sq. in.
Bell	21¼	371.54
Bell, less 9¼-in., less 3½-in. pipes	...	287.26
Outside large siphon	9¾	74.66
Inside large siphon	9	63.62
Outside auxiliary siphon	3½	9.62
Inside auxiliary siphon	3	7.07
Inside 2-in. pipes	2	3.14

One atmosphere taken at 10.70 pounds

9-in. pipe to floor		63.62 sq.in. ×	85 in.	= 5,407.70 cu.in.		(1)
9-in. pipe to bottom		63.62 sq.in. ×	163 in.	= 10,370.06 cu.in.		(2)
Bell above 9-in. pipe		371.54 sq.in. ×	4 in.			
Less		9.62 sq.in. ×	3 in.	= 1,457.30 cu.in.		(3)
Bell to 2 in. below top of 9 in. pipe (371.54—74.66—9.62)		287.26 sq.in. ×	2	in. = 574.52 cu.in.		(4)
3-in. auxiliary	(Press.)	7.07 sq.in. ×	78	in. = 551.46 cu.in.		(5)
3-in. auxiliary	(Atmos.)	7.07 sq.in. ×	12	in. = 84.84 cu.in.		(6)
2-in. vent	(Press.)	3.14 sq.in. ×	6	in. = 18.85 cu.in.		(7)
2-in. vent	(Atmos.)	3.14 sq.in. ×	79.75	in. = 250.64 cu.in.		(8)
2-in. siphon	(Press.)	3.14 sq.in. ×	232	in. = 729.14 cu.in.		(9)
2-in. siphon	(Atmos.)	3.14 cu.in. ×	154	in. = 484.00 cu.in.		(10)

When the main siphon chamber is full of water the air pressure inside of the bell is 1.264 atmospheres. Therefore, from equations above

(2)	10370.06 cu.in.
(3)	1457.30 cu.in.
(4)	574.52 cu.in.
(5)	551.46 cu.in.
(7)	18.85 cu.in.
(9)	729.14 cu.in.
	13701.33 cu.in. × 1.264 = 17,318.49 cu.in. at atmospheric pressure

When operation begins the pressure is atmospheric.

(1)	5407.70 cu.in.
(3)	1457.30 cu.in.
(6)	84.84 cu.in.
(8)	250.64 cu.in.
(10)	484.00 cu.in.
	7684.48 cu.in.
	17318.49 cu.in.

Then

	7684.48 cu.in.
	9634.01 cu.in. is the volume required in the bell below the top of the 9-in. pipe; and
	9634.01
	287.26 = 33.53 in. = cut-off of vent below top of 9-in. pipe.

Starting Bell—At atmospheric pressure:

2-in. pipe	214.375 in. × 3.14 sq. in.	= 673.75 cu.in.
9-in. pipe bell	18.000 in × 63.62 sq.in.	= 1145.16 cu.in.

or a total of 1818.91 cu.in. and at a pressure of 1.264 atmospheres this is 1432.21 cu.in.

With pressure at 1.264 atmospheres there is needed, 2-in. pipe 294.375 in. × 3.14 sq.in. = 925.18 cubic inches. There will therefore be a surplus space inside of the starting bell of 1432.21 — 925.18 = 507.03 cu.in., which makes the water level inside the bell when operation begins 507.03/63.62 = 8 in. below the top of the bell. This allows sufficient surplus air to make satisfactory operation certain.

On account of slight variations in final dimensions from the figures used in the preliminary design the siphon did not operate at exactly the calculated elevation of water in the chambers. To adjust this, the Harding vent was cut off a little, but the principle, of course, was not changed, and after that slight adjustment was made the siphons worked perfectly.

Costs of Concrete Canal Lining Compared

A comparison of the cost of lining the canals of the Orland Project of the U. S. Reclamation Service in California has been made for the period previous to 1918, for the 1918-19 season and the 1919-20 season. It indicates a gradually rising cost for material and labor and a decrease in superintendence and general expense. A. N. Burch, project manager, gives the figures in the *Reclamation Record* for March. Because of the demonstrated success of earlier work in maintenance costs and water saved a decision was made to line the whole of the 70-mile distribution system, involving 650,000 sq.yd. of concrete. About 120 days only is available each year between irrigation seasons. Substantially the same methods have been used throughout. The relative economy of the 1919 results is due largely to better organization, careful co-ordination of the different operations involved, and unremitting attention to details.

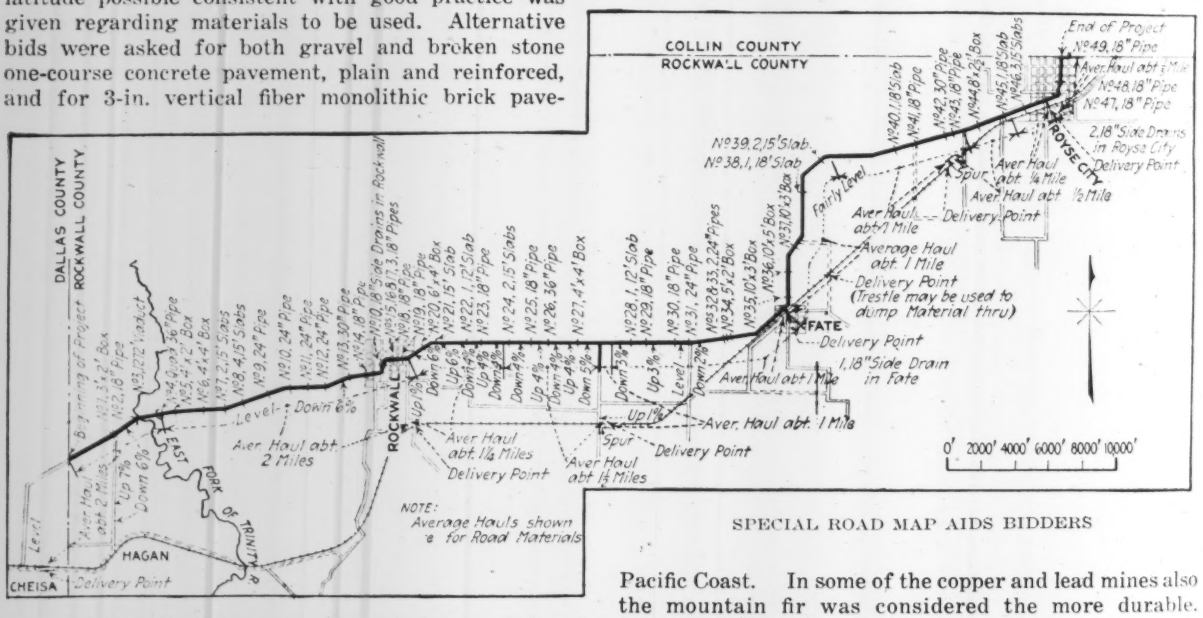
	Prior to 1918	1918-19	1919-20
Cement	$0.0977	$0.1200	$0.1260
Sand and gravel	0.0424	0.0535	0.0643
Labor, preparing canal	0.0691	0.0738	0.0853
Labor, mixing	0.0301	0.0392	0.0293
Labor, placing	0.0307	0.0413	0.0564
Labor, sprinkling	0.0043	0.0052	0.0013
Engineering and supervision	0.0292	0.0230	0.0259
Equipment maintenance	0.0074	0.0062	0.0088
General expenses	0.0438	0.0272	0.0311
Total per square yard	0.3547	0.3894	0.4248
Quantity, square yards	267,320	57,880	30,000

Selling Methods For Highway Work

BY JULIAN MONTGOMERY
County Engineer, Rockwall County, Texas

A DEFINITE selling plan secured bidders for the Bankhead highway in Rockwall County, Texas, when contracts elsewhere were going begging. Maps, specifications and proposals were all prepared with the definite purpose of selling the contract.

When ready to let the contract every available weather forecast was closely studied in order to choose favorable weather for the period of advertising, when the contractors would be inspecting the job. Care was taken in the preparation of the "proposals" to let it contain all the essential data, arranged in such a way that the principal quantities would immediately attract the eye. This official proposal was placed in two of the leading state newspapers located in opposite parts of the State, and in the *Engineering News-Record*. It was run for three weeks and called for the construction of an 18-ft. concrete or brick road including a concrete viaduct over the East Fork Trinity River. The greatest latitude possible consistent with good practice was given regarding materials to be used. Alternative bids were asked for both gravel and broken stone one-course concrete pavement, plain and reinforced, and for 3-in. vertical fiber monolithic brick pavement. Alternative bids were also asked for reinforced concrete, segmental block and double strength vitrified clay pipe for culverts.



SPECIAL ROAD MAP AIDS BIDDERS

A layout map was prepared to a scale of 1 in = 2,000 ft., showing the location of the road to be constructed, all drainage structures (including size and number) all intersecting roads, adjacent railroads, towns, delivery points, average hauls from each delivery point, and controlling grades of all roads over which material was to be hauled, together with a table showing the size of each drainage structure and the quantities of materials contained in each. Lists were prepared giving the locations and addresses of all sand and gravel pits, rock quarries, cement and brick plants, mill agents, etc., for a radius of 50 mi.

Six complete sets of road plans were kept on file in the county engineer's office, available for inspection at all times. For a week after advertising was begun, specifications, proposals, layout map, etc., were sent only to those who wrote for them or otherwise requested them. At the end of a week, however, all available data were sent to every large responsible contractor in Texas and to several outside of Texas. These data included specifications, proposals, list of material locations, layout map (described above) and blueprints of the principal drainage structures.

Quite a number of contractors became interested, and about twelve agreed to submit bids. Five of them dropped out for various reasons. Of the seven left, everyone bid, but six of them collaborated in pairs making four bids received from the seven contractors. The bid accepted was for an 18-ft. one-course gravel concrete pavement, reinforced over fills and was submitted by T. J. Worthington and MacElwrath & Rogers, of Corsicana, Texas. The bid was reasonable, wonderfully well balanced, and was between 3 and 4 per cent higher than the writer's estimate which was made some two months previous.

Relative Durability of Douglas Fir Ties

Railroads using Douglas fir ties have held the opinion that the Douglas fir grown in the Rocky Mountains was more durable than that grown on the Pacific Coast. In some of the copper and lead mines also the mountain fir was considered the more durable. While no authentic records are available where coast and mountain fir ties are laid in the same locality, such service records as there are, according to the Forest Products Laboratory, fail to show that the Mountain fir has superior lasting qualities. In some instances the mountain fir and in others the coast fir has proved the more durable. Botanically there is no difference in Douglas fir according to the locality in which it grows. Tests made by the laboratory indicate that Pacific Coast fir is on the average somewhat denser and therefore stronger and harder than mountain fir. The parts of coast timber usually cut into ties are boxed hearts or wood cut near the piths or from the tops of trees. These are the poorer parts, and coast fir ties therefore generally contain no better wood than mountain fir ties. The conclusion of the laboratory is that there is practically no difference in the durability of Douglas fir ties cut in the mountains and those cut along the Pacific Coast, but it has been observed that the latter take preservative treatment a little more readily than the former.

LETTERS TO THE EDITOR

"Business" and "Professional" Classification for Engineers Suggested

Sir—The classification of engineers into "professional" and "business" engineers seems to be crystallizing. One's instinctive sympathy goes perhaps to the professional—the man who is faithfully following the more or less painful route to technical excellence and service, although it must be remembered that many men fall in this class more because they lack imagination and initiative than because they love the science. However, it seems regrettable that the world's reward often goes not to the reticent though highly developed technical mind, but to the shrewd, acquisitive or aggressive person, seemingly regardless of his genuine engineering qualifications. In all the hubbub about compensation of engineers, this side of the matter deserves consideration. I have wondered whether the compensation committees have ideas or programs that touch this particular problem. "BUSINESS ENGINEER."

Progress in Two Directions

Sir—Regarding the article of John R. Downes on "Utilizing Imhoff Sludge on Land" in your issue of April 29, it is pleasing to see a record of real industrial progress in two directions:

1. During the last fifty years we have read and heard much from men who worked in theoretical atmospheres, but were not engaged in practical pursuits, about great wastefulness in communal activities. These statements and arguments were often good and true. Yet they were vain and fruitless, because they overlooked the fact that the labor required to save was greater than the labor required to produce. As it actually cost me more for labor to sift my furnace ashes and rescue one pound of unburnt cinder than to pay for one pound of new coal of equal calorific power, I stopped the sifting. It would seem that this should not be, nevertheless with the available present efficiency it was so.

As we advance in civilization, accumulating more knowledge and acquiring more skill, less labor will produce the same result. The enormous amount of labor employed by the Egyptians to build their pyramids would today be comparatively slight, as we would substitute steam power, modern machinery, and better efficiency in management.

Mr. Downes has done for us what Imhoff and his associates did for Europe, namely, raised crops of corn and oats on inoffensive sewage sludge at much less than the usual cost. No doubt this experience will give encouragement for similar trials and advancement elsewhere.

When I studied engineering the idea was impressed upon me that the fairest and best way to measure the real value and cost of work was *not* by days' wages, which differed in every country and in the same country from decade to decade, and were also dependent on boss rule, irrespective of personal skill and industry of the individual. However, this method has persisted and is still widely practiced at the present time.

A far more rational way, we were then told, and one constantly tending to develop greater skill in the worker and greater inducement to his advancement, is to measure the cost by man-hours, wherever practicable. This better method has unfortunately been resisted in practice, partly by ignorance, mostly by those who played upon innocent minds, against their own real advantage and in favor of fancied or temporary advantages, who felt no interest in securing better work from others, nor were they the real friends of progressive labor. Piece and contract work are now the nearest approach to the man-hour method. The best man gets the greatest return.

If, in addition to valuing its quality, work were more generally measured by the amount a man can do in one hour, we would then have accumulated records of the number of hours required by one active laborer, and one slow laborer, for instance: To excavate a cubic unit of different soils and gravels under varying conditions of wetness; to blast and remove a cubic unit or rock, soft, hard, massive or laminated; to build different classes of masonry, either in bulk or in a wall or as columns; to sweep 1,000 sq.yd. of asphalt, Belgian block or cobble stone pavements; and similarly, to do all kinds of construction or maintenance work, entirely independent of wages for each kind of work. Such records are numerous in European textbooks.

Mr. Downes contributes also to this class of information, which, if generally recorded for all classes of work, would indeed, viewing the present uncertainties of wages, cost of living, and cost of works, make a more "blissful world" for the engineer and others. To ascertain the probable unit costs of new works, we would simply multiply the universally established man-hours, if they were available, according to the character of the labor available, by the wages prevailing on the day of the estimate, and have a more rational, more reliable and more just basis than we now have for making our estimates. And more important still, it would be easier, and rest on a more practical and sound foundation, to increase, according to actual merit, the present rewards for honest, capable, and striving labor.

Montclair, N. J. RUDOLPH HERING.

Hudson Vehicle Tunnel Designs

Sir—I beg to correct a misapprehension occurring in your article of April 15, p. 777, in an article, "Hudson Vehicle Tunnel Designs and Bidding Methods," quoting from the reply by C. M. Holland, Chief Engineer, to a memorandum of General George W. Goethals, where Mr. Holland is apparently misled by a recorded and somewhat cursory recollection on the part of the late General Raymond, who was chairman of the Board of Engineers of the Pennsylvania Railroad Company's extension to New York City.

In this statement of Mr. Holland's there is considerable, though unwitting, misapprehension of the character of the cast-iron lining of the Pennsylvania Railroad Company's tunnels under the Hudson River, and with the approval of Samuel Rea, President of that Company, the following correction is submitted:

First—While it is true the "ordinary" lining of the Pennsylvania Railroad Hudson River tunnels has been sometimes referred to as "light" iron, it should not be thus designated. This lining was and is the standard lining adopted and installed.

Second—The "heavy" lining as distinguished from the "ordinary" was not used for the entire length under the Hudson River through the silt. There, under the river, all in silt, the lengths were as follows: "Ordinary" (or standard) lining 3,318 ft.; "heavy" lining 5,522 ft. As compared with the "heavy" lining under the river, the "ordinary" lining in this location was subjected to much greater stress and distortion, caused by construction methods which were later modified. Though thus severely tested and distorted, it remained intact and returned after a lapse of time to almost its true circular shape.

Third—The "heavy" lining referred to was this same "ordinary" or standard lining, thickened in the skin and in the flange, as the means of increasing the *weight* of the tunnel, to meet the at-the-time suspected buoyant force, with no intention of but incidentally increasing its strength. The flange depth was not increased.

Fourth—This "ordinary," or standard, lining, erroneously referred to as "light" iron, was designed as a permanent structure of adequate strength to alone support all forces without the assistance of the inner concrete lining. In actual construction it was, in this respect, adequately tested during the two to three years after the entire iron lining was erected and prior to installing the inner lining of concrete. This interior concrete lining was adopted as an additional measure of insurance in protecting the iron lining from railroad accidents and fire, as well as giving a durable high-class masonry interior finish with many accessory uses.

Fifth—Not one single crack in this "ordinary" lining,

or for that matter the "heavy" lining, occurred under the river due to silt stresses. The only, and insignificant, cracks which occurred were one transverse crack in one flange of each of five segments of the "ordinary" lining, and one similar crack in a segment of the "heavy" lining, due possibly to rough usage in handling, but more likely to shield jack thrusts, none of them in the least detracting from the satisfactory results of the work. The "number of cracks" referred to as having occurred during construction were in the tunnels under the land. On the Manhattan side they were entirely confined to one tunnel and on the New Jersey side they were largely confined to one tunnel, and almost all of them were due to causes we are satisfied should not recur. None of these cracks necessitated the removal of any segments.

Finally—Should these tunnels be reproduced today, the "ordinary" (or standard) lining would be used throughout the entire length of over 12,000 ft., except where special cast steel lengths are used in passing under bulkhead walls or such locations, giving irregular and excessive loads, but this applies to but a few hundred feet of the length of the entire tunnel.

These statements of fact require no substantiation, but it is none the less satisfactory to recall their conditioning is well recorded by the papers of Messrs. Hewett and Brown, in the *Transactions* of the American Society of Civil Engineers, Vol. 68, September, 1910—for example, on p. 214, where reference is made to the suspicion that the tunnels were subject to a buoyant action, deciding the use of a *heavier* type of lining; on p. 228, where the cause of this alarm is found to be due to driving the shields "blind," causing the tunnels to rise, and so forth . . .; on p. 249, where consequences occasioned by thus driving the shields "blind" not only caused a rise of the tunnels but distortion from its circular shape. In these papers of the American Society no reference is made to a "light" type of lining; we had no such classification nor the necessity for it.

In discussing this matter yesterday with Mr. Lindenthal, for a time a member of the Board of Engineers of the Pennsylvania Tunnel Extension and later one of those consulted on the occurrence of this phenomenal behavior of the tunnels, he recalled considering increasing the weight of the tunnels temporarily during construction by ballasting in the invert and later by permanently increasing the thickness of the upper two-thirds of the internal concrete lining 6 in. In this way the weight of the completed tunnel would be increased practically to the same degree as was done by increasing the thickness of the metal lining one-half inch. The idea of increasing the thickness of the concrete was of course a passing thought; by so doing it would have robbed the tunnel of much necessary space.

April 30, 1920.

New York City. JAMES FORGIE,
Chief Assistant Engineer during Design and Construction.

Glad Question 3 Was Defeated

Sir—The editorial on the results of the American Society of Civil Engineers' questionnaire in your issue of April 22, p. 795, is of interest to all members of that "ancient and honorable" society, but particularly so to some who are, as I am, also members of the American Association of Engineers. Had these questions been submitted to us five years ago, I should have voted "aye" on No. 3. As it was, I voted "no"; and was active in my efforts to get my fellow members to see it as I did.

For many years I felt that there was an element missing in the American Society of Civil Engineers. The intellectuality was there, the sporadic sociability was there, but the interest in the members as human beings whose lives, liberties and pursuits of happiness depended upon such vital things as employment and compensation, was wanting. This lack of human interest was made shockingly plain to me when, a few years ago, I tried to invoke it in behalf of a worthy member who was being unjustly treated through political influence in Washington. I found then that it was simply non-existent.

When the American Association of Engineers was started by a small group of earnest young men, I suspected it of being a labor union affiliation and held aloof for a time. Finally, it came into the minds of some of the older engineers that a movement had been inaugurated which, under proper guidance, could be a boon to the profession and which, on the other hand, might, if antagonized, become a harmful agency. Well, we came into the movement and the counsel of the old men and the action of the young evolved a vigorous welfare organization on proper lines, with the golden rule as its standard of right and fellowship.

The astonishing progress made by this organization proved that it met a need of the engineers in every branch of the profession, for it opens its arms to them all. Its growth commanded attention and excited—shallI say jealousy or only a spirit of emulation. In my judgment, whichever it was, it was awakened too late.

The organization was a going concern, functioning with vigor and doing its work so well that it deserved support and not opposition. Therefore, I opposed Question 3 and am glad it was defeated.

As "nothing succeeds like success," the future of the American Association of Engineers is assured.

ISHAM RANDOLPH,
Consulting Engineer.

A Reverse Curve Problem

Sir—Referring to W. H. Adams' letter to the editor in your issue of April 22, p. 833: He is mistaken in the statement that his solution of the reverse curve problem has not found its way into the handbooks. Nagle's Field Manual for Railroad Engineers, edition 1897, p. 72, gives this solution.

Using Mr. Adams' notation, the length of the rerquired tangent, *AM*, is determined from triangle *OSZ:*

$$AM = OS = \sqrt{OZ^2 - SZ^2}$$

$$\cos \nabla = \frac{SZ}{OZ}$$

A. C. LOVE,
Professor of Railway Engineering, Texas Agricultural and Mechanical College.
College Station, Texas.

British Engineers' Fees

The council of the Institution of Civil Engineers (British) has had under consideration certain inquiries from members as to the propriety of increasing fees over pre-war rates. Dealing first with the commission charged for the design and superintendence of the construction of works, the council find themselves in a little difficulty, in that the increased cost which the engineer has to incur under post-war conditions is met by the increased cost of the work on which he charges commission. But this evidently only holds good so long as the work is executed at pre-war speed. The question of fees will depend therefore on the cost of the works and the contract time for completion, and it would certainly be proper to stipulate for an extra fee in the event of the work seriously exceeding the contract time owing to unforeseen difficulties with labor or supply of materials. With regard to the fees charged for other classes of work, however, such as enquiries, reports, and Parliamentary work, the same considerations do not arise, and the council of the institution express the definite opinion that civil engineers are justified in making an advance of 50 per cent on pre-war rates. These decisions will come as a considerable relief to many engineers who have been feeling the full strain of the constant increase of office and living expenses, and at the same time it is plain that the legitimate interests of clients have not been overlooked. It now only remains for the members generally to adopt the higher scales that have been approved by the institution.—*The Surveyor.*

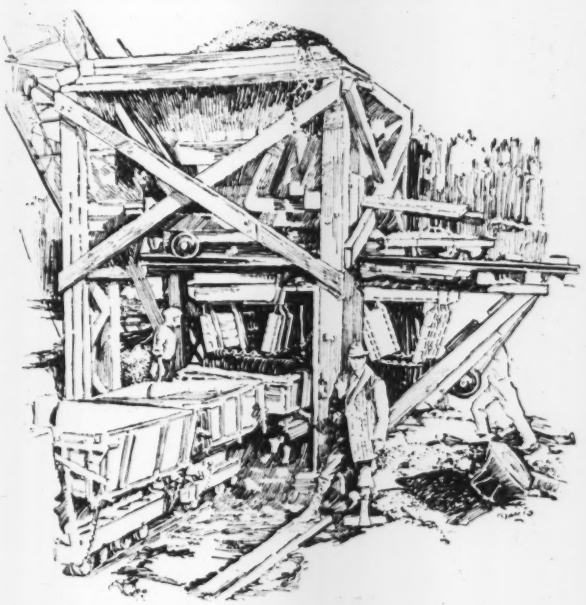
HINTS FOR THE CONTRACTOR

Car Loading Hopper for Draglines and Grab Buckets

By R. E. Post
Seattle, Wash.

IN LOADING small cars with draglines or grab buckets it is essential to have a hopper because it is difficult to spot the bucket sufficiently close for satisfactory loading. In the design of such a hopper several considerations must be taken into account. (1) It should be so arranged that a dinkey can pass under it or at the side of it. (2) The fall of the material must be broken so that it will not break car doors and bottoms. (3) The hopper should be light enough and, at the same time, strong enough to be moved quickly without cleaning out the accumulation of material in the corners.

The side-loading hopper is not satisfactory for ordinary damp or wet material. In a straight drop hopper



MOUNTED MOUTHPIECE MOVED FROM UNDER HOPPER ON TO BUCKET FOR DINKEY TO PASS

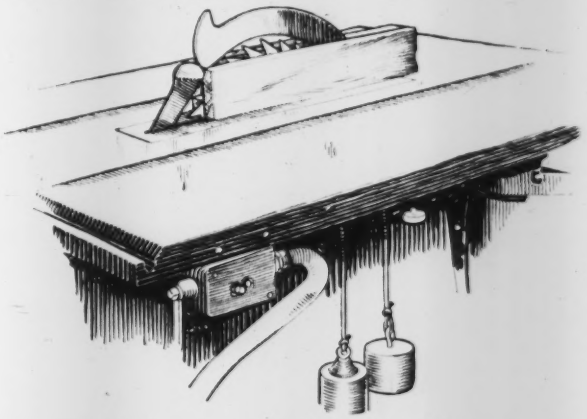
the fall of the dirt when the opening is high enough to allow a dinkey to pass is so great that large rocks will break car doors and bottoms. To secure the advantages of a straight drop hopper, and not break up cars, the arrangement shown in the cut was devised.

The hopper itself is of the usual type mounted on rollers. Below the hopper is a carriage carrying a mouthpiece to which are hung two adjustable deflector doors. The carriage runs on rails fastened to the hopper timbers, is controlled by an endless line operated by a hand winch, and is moved in for loading and out for the dinkey to pass. The deflector doors may be adjusted so as to break the fall of the material.

This was the cheapest and most successful of a number of hoppers of different types used during the construction of the Keechelus Dam at Meadow Creek, Wash.

Guard Insures Sawyer's Safety

THE accompanying sketch illustrates a saw guard consisting of two curved arms, mounted so that they revolve about the same center as the saw. Upon pushing a piece of lumber against the free end of the arm above the saw it revolves, the free end rises until it rests upon the surface of the lumber. This sketch indicates two things: first, how the arm in front of the

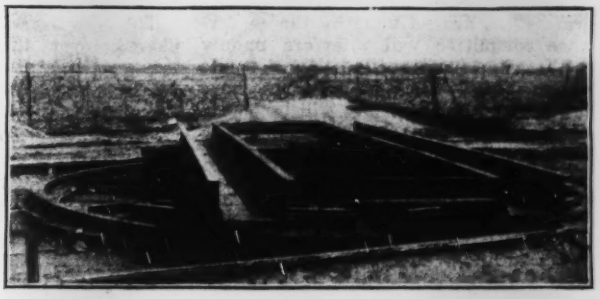


saw comes into action, maintaining at all times a complete screen in front of the saw teeth; second, that the arm above the saw not only serves as a guard above the teeth, but acts as a splitter behind the saw, so preventing the "kickback" which is one of the most serious dangers with a saw. If the lumber is thicker than the exposed portion of the saw, and it is desired to saw a groove in it, the arm above the saw simly retreats entirely and disappears beneath the table. The arms are actuated and kept in proper position by counterweights. The sketch and subject matter herein reproduced are taken from a recent bulletin of the United States Bureau of Labor Statistics.

Turntable for Trucks

By F. W. Epps
Bridge Engineer, Kansas Highway Commission.

IN the constructing of hard surfaced roads in central Kansas, the contractor has designed a turntable of channels for turning trucks for unloading. The truck is driven onto the turntable, turned around, dumped and run out. The contractor has also provided a wooden track of a U shape which is made in 9-ft. section. This track is used to keep the trucks from cutting up the subgrade. The track connects with the turntable.



NEWS OF THE WEEK

New York, May 13, 1920

Contractors To Investigate Material Prices

To Co-operate with Material Dealers In Effort to Reduce High Construction Costs

At a conference of representatives of the leading construction firms of the United States, called by the Associated General Contractors of America at Chicago, April 23, a committee was appointed to investigate present high prices of construction material with a view to eliminating the causes and bringing about a reduction in prices. The committee was authorized to invite the co-operation of material dealers and manufacturers in making an analysis of the present cost of production, and, if necessary, to request the assistance of the Federal Trade Commission in investigating existing conditions. The contractors plan, also, to include in the scope of their investigations, the relationship of present currency inflation, labor inefficiency, and so-called luxury production, both in construction and in other fields, all of which are blamed for existing high prices. If necessary, they will recommend legislation looking toward a solution of present conditions.

W. A. Rogers, president of the Associated General Contractors of America and president of Bates & Rogers Construction Co., Chicago, Ill., who presided at the conference, stated that "the leading construction firms of the country have come to the conclusion that the contractors should no longer pass the buck to the ultimate consumer and therefore must take a hand in starting a movement to secure determined action, looking toward relief."

Water-Power Bill Held Up in Senate

Serious opposition to the Water-Power Bill has developed in the Senate. The measure was recently reported out of conference and the House of Representatives, by an overwhelming vote, 259 to 30, adopted the bill as agreed upon in conference. Certain interests in New England, however, are convinced that the definition of "navigable waters" as agreed upon by the conference committee will interfere unduly with private enterprise. As a result several New England senators have organized what probably will become a filibuster, unless the bill is changed so as to meet their demands. The opposition is based on the fear that permission of the Federal Government will have to be secured for any activity, not only on navigable streams but on all tributaries. There is also objection to any licensing system.

A. A. E. Approves Home-Building Project

By Telegraph from "Engineering News-Record's" Western Editor

Plans for group insurance, and the formation of a home-owning and building company were authorized by the American Association of Engineers at its sixth annual convention held in St. Louis, Mo., May 10th and 11th. Seven corporation trustees, elected by the Board of Directors, are to formulate plans and handle the new company without involving financial obligations by the Association. An existing 21-story building in Chicago is under consideration.

The Board of Directors has accepted the invitation of the Joint Conference Committee of the Founder Societies to send delegates to the Organizing Conference in Washington, D. C., June 3rd and 4th. With regard to the principles underlying the proposed federation of Engineering Societies, the A. A. E. passed a resolution approving the non-interference and local affiliation clauses, but objected to a national federation as being unnecessary machinery, which would duplicate that of the American Association of Engineers, which is now functioning.

It is believed that the proposed federation will receive little or no financial support from A. A. E. The Association's delegates, however, will present to the Organization Conference certain suggestions on the subject of united action by the Engineering profession.

Engineering Institute of Canada to Fix Rates of Pay

At a special conference of members of the Engineering Institute of Canada, held in Montreal, April 13, to consider matters related to the material welfare of the membership, a resolution was passed calling upon the society's council to appoint a Committee on Policy and to approve the establishment by the Institute of rates of remuneration for its members, both by fee and by salary.

Tunnel Bill Passed Over Veto

The New Jersey Assembly on May 5 passed, over the veto of Governor Edwards, the Hudson Vehicular Tunnel and the Delaware River Camden-Philadelphia Bridge Bill, providing for a $28,000,000 bond issue for New Jersey's share, upon the approval of the voters of the State at the next election. The direct tax feature, for paying the interest on the bonds, which was objected to by Governor Edwards, is retained in the bill as passed. The Senate passed the bill May 11.

New York State Highway Program Suspended

Commissioner Greene Announces Withdrawal of All New Construction Because of High Costs

In accordance with his recent published statement to the Governor of New York, that all new construction would be suspended because of the high prices of labor and materials, State Highway Commissioner F. S. Greene withdrew all bids advertised for the letting of May 5. Eleven roads in eleven separate counties and aggregating approximately 40 miles of various types of surfacing, most of it cement concrete, were included in the May 5 advertisement.

Inasmuch as Commissioner Greene has received but thirty acceptable bids upon seventy highways advertised as new construction; inasmuch as in submitting a bid a contractor must at the most equal the engineer's estimate; and in view of the excessive cost of labor, materials, and the lack of transportation, Commissioner Greene thought it best to discontinue all new construction not already contracted for. His full statement giving reasons for such discontinuance was recently addressed to Governor Smith and is reprinted herewith:

In November, 1919, this Commission outlined its road construction policy for 1920, and published a program of individual roads proposed to be constructed. This program was based on, and with the hope that conditions would not be materially different from those of 1919.

In accordance with that published program four lettings have been held covering seventy highways, but only thirty acceptable bids were received and these lettings showed that there was little or no competition among contractors. In the last letting of April 16th, including fifteen new highways, only five acceptable proposals were received. Since then there have been sharp advances in the cost of materials.

After a careful analysis of the situation it is evident that it is not good business or for the best interests of the State to continue the proposed program, and this Commission has determined to withdraw all roads advertised for new construction in the letting of May 5th, and wishes to announce that there will be no further new roads offered for construction until the situation shows a decided change for the better.

Advertisements for maintenance work will be continued and it is proposed to devote every energy of the Department to the completion of existing construction contracts and the maintenance and repair of our present road system. The conditions which have forced this Commission to defer new construction are briefly as follows:

1. Shortage and high cost of labor.
2. Shortage of railway cars and uncertainty of transportation.
3. Lack of competition in bidding.
4. Seemingly unjustifiable advance in cost of materials.
5. Commercial quarries restricting output and in some instances closing down.
6. Necessity of assuring,—by utilizing labor which would otherwise be diverted to new work,—the completion of the maintenance program which because of the present condition of our highways is an economical necessity and more essential than new construction.
7. The obligation of the State to protect

existing contracts from labor shortage by not offering new work, at advanced prices in competition, thus insuring the completion of all existing contracts. At present there are 183 uncompleted but active contracts with approximately 600 miles unfinished. If the policy is pursued of constantly increasing estimates and permitting contractors to bid against themselves at ever-increasing prices, the same condition would be created that existed from 1915 to 1919 when there were broken down and abandoned contracts, representing approximately 850 miles of torn up highways, in practically every county in the State.

As soon as the conditions mentioned above show a change for the better and it is clear that road work can be continued economically and without detriment to the State's interests, the program for new construction announced by this Commission for 1920 will be resumed.

Voters Fail To Approve $15,000,000 for Cleveland Subway

As announced in these columns April 29, the $15,000,000 bond issue for the construction of street-car subways in the downtown sections of Cleveland was defeated at the polls April 27 by a vote of more than 2 to 1. Linked with the issue was another for $2,000,000 bonds for the completion of the new jail and criminal courts building, which was in addition to nearly $2,000,000 appropriated for this purpose three years ago. The voters killed this measure by a vote of nearly 5 to 1. A measure for $3,500,000 bonds for a new city hospital carried almost unanimously.

Chief reasons advanced by opponents of the subway measure were that the time is inopportune, because housing, rather than public improvements, is most needed now; that the plan for the subways as it stands does not mean real rapid transit; that the real purpose of the construction—to place trolley cars underground and relieve streets of traffic congestion—does not now justify the cost of the project.

Fielder Sanders, street railway commissioner; H. L. Davis, mayor; C. A. Otis, head of the rapid transit commission, and other advocates of the subway bond issue expressed surprise at the overwhelming criticism of the measure, but looked upon its defeat as but temporary. The contention is advanced that delay in this project will make traffic congestion intolerable.

The subway project was developed by Barclay Parsons & Klapp. It provided for underground routes leading from different sections of the outskirts of the business district to a central station under a public square, with transfer terminals. The lines leading to the edges of the business district included those along Euclid Ave. to East 22nd St. Superior Ave. to East 12th St., West Superior Ave. to the new high level bridge, Ontario St. south to Market House.

The city was to build the subways and equip them, with the exception of power and cars, and rent the system, at 6 per cent of the cost, to the Cleveland Railway Company.

The cost of operating the system was to devolve on the railway company, but the cost of construction, leaders in opposition to the plan claimed, was to be borne eventually by the people in increased taxation.

Engineer Licensing in Canada

Licensing of engineers is provided for in legislation recently enacted in British Columbia and Manitoba. The current *Journal* of the Engineering Institute of Canada says that in New Brunswick and Nova Scotia during the present sessions of the Legislative Assembly other professional engineering acts will have been passed. The Alberta Act was passed recently. In Quebec there has been established the corporation of professional engineers. In Ontario the matter of arriving at an acceptable bill is in the hands of an advisory conference committee. In Saskatchewan changes were suggested by the Premier which caused the bill to be withdrawn. The success attending the bill in British Columbia and Manitoba will, it is believed, have a beneficial effect on Saskatchewan legislation.

Atlantic County Lets Costly Highway Contract

Atlantic County, N. J., has recently let a contract for the construction of 8.09 miles of Warrenite surface paving to the Standard Bitulithic Co., Newark, N. J., for an average price of $73,476.03 per mile. The road to be improved is what is known as the Pleasantville-Mays Landing Road. Though the contract price appears high, it includes heavy excavation, the construction of a concrete base, the laying of surfacing 20 ft. wide, and the construction of 5-ft. shoulders. Other items are also included such as drains, head walls, guard rails, etc. Unit prices were $1.92 for excavation; $2.59 per square yard for a 6-in. concrete base; $2.50 per square yard for Warrenite surfacing, and 74c. per square yard for crushed rock shoulder.

Concrete Ship "Polias" Still on Rocks

Captain E. M. Mills, of the U. S. Coast Guard Station at Burnt Island, near where the concrete steamship "Polias" was wrecked some months ago, has written to Lewis R. Ferguson, who investigated the condition of the ship for the government, as reported in *Engineering News-Record*, March 4, 1920, p. 483, as follows: "The old steamer still lies in the same position, and though severe storms have washed over and around her since you were here she remains the same. No apparent change has been noticed, and, with the exception of the paint washing off, I do not believe the hull has been damaged in the least. I am still of the opinion that the concrete boat is, if kept off the rocks, the strongest built ship afloat, as no steel nor wood ship would have stood the severe storms that have beaten against the 'Polias' during the last two months with such little damage done."

The U. S. Shipping Board has not made any announcement as to its intention regarding the disposition of the ship.

Public Works Fund Now $20,000

Contributions to the fund being raised by the National Public Works Department Association totaled $20,184.06 on May 5. The campaign is planned to yield about $78,000 and to each state is assigned a quota of this amount. On this basis New York is expected to yield $20,000; Illinois, $10,000; Pennsylvania, $8,000. From these amounts the sums range to $100 for such states as Nevada, Vermont, South Carolina, and others.

Civil Engineer Killed While Acting as Switchman

Loyalty to his employer during the recent switchman's strike resulted in death for J. W. Wilkinson, office engineer, Nickel Plate. While performing extra duty as a switchman in the yards in Cleveland he received injuries, April 23, from which he died the next day. Mr. Wilkinson was an active worker in the Cleveland Chapter of the American Association of Engineers. His record is simply given as No. 3363; graduate of Allegheny College; in railway work as a civil engineer 21 years.

Annual Convention, Tri-State Water and Light Association

The Tenth Annual Convention of the Tri-State Water and Light Association of the Carolinas and Georgia will be held at the Piedmont Hotel, Atlanta, Ga., June 19-21. The program will be divided between water and light subjects. Among the topics to be discussed which will be of interest to water-works men are fuel oil, filtration of turbid river waters and water-works extensions. There will also be an "Exhibitors' Night," May 20, for the display and demonstration of exhibits by representatives of manufacturers. W. F. Stieglitz, secretary-treasurer, Columbia, S. C., is convention manager.

Contractors Define Practice Outside Home Territory

To correct the practice of bidding up wages, which is followed by some contractors who undertake an occasional operation in new territory, thus disturbing the labor conditions under which contractors native to that territory are operating, the Associated General Contractors of America have enacted the following by-law:

"Firms or corporations, members of any associated organization of the Associated General Contractors of America, who shall undertake a construction contract outside the jurisdiction of the associated organization of which they are members and within the jurisdiction of any other associated organization, should affiliate with said other associated organization and abide by its rules and regulations at least for so long as said firm or corporation shall continue to undertake construction work within that jurisdiction."

Government Pays for Boston Dry Dock

The Federal Government, through the Navy Department, has paid the State of Massachusetts $4,158,385.58 for the 1,200-ft. dry dock at Boston, alongside of the Army Supply Base. The dry dock was built by the state.

To Complete Montreal Aqueduct

By action of the Administrative Commission of Montreal a Bureau of Works for the Enlargement and Improvement of the Aqueduct has been created consisting of A. E. Doucet, director of public works, chairman; R. S. Lea and Walter J. Francis. This bureau, subject to the direction of the commission named, is "to study in all its details the question of the establishment of a water-supply service sufficient for all the requirements of the city, which shall comprise the creation of power—hydraulic, electric or otherwise—the enlargement of the filtration plant, prepare the plans, specifications and estimates on this subject, and to supervise all the work that is executed." Messrs. Lea and Francis are to be paid $10,000 a year for their services, including all the time necessary "to see that the plans are promptly prepared and the work carried out in an efficient manner, but they shall not be required to give more than 200 days' service a year." A report on completing the aqueduct enlargement, and on other extensions of the work, was made early this year by R. S. and W. S. Lea (see *Engineering News-Record*, March 4, 1920, p. 491).

Bureau of Water-Works Extension Formed at Columbus, Ohio

To carry out the water-works enlargement at Columbus, Ohio, recommended last year by Prof. John H. Gregory, Baltimore, Md., and for which $3,000,000 of bonds were voted last November (see *Engineering News-Record*, Nov. 13-20, 1919, p. 885) a Bureau of Water-Works Extension has been created by ordinance. The bureau will be a part of the Water-Works Division of the Department of Public Service. Professor Gregory has been appointed consulting engineer and C. B. Hoover has been appointed engineer in charge of the bureau. Engineering positions not yet filled are an office engineer, two field engineers, four assistant engineers, four transitmen, eight rodmen, six draftsmen and two inspectors. Professor Gregory had charge of the building of the new water-supply works and sewage-works some years ago and for four years Mr. Hoover was under Mr. Gregory on those works. For some ten years past Mr. Hoover has had charge of the operation of the Columbus sewage-works and sewage pumping station and has also done considerable engineering work for the Water-Works Department, the department being responsible for the operation of the sewerage system as well as the water-works.

Begin Hearings on Townsend Road Bill

Hearings were begun last week on the Townsend Road Bill before the Senate Committee on Post Offices and Post Roads. As explained by Senator Townsend, the hearing will attempt to develop whether Congress should continue its present system of Federal aid, whether it is to appropriate larger sums to use after 1921, or whether it is to make a change in its road policy.

Among those who appeared before the committee was M. O. Eldridge, director of road activities of the American Automobile Association. Prior to his connection with that organization he was, for twenty-five years, in the service of the Bureau of Public Roads. Mr. Eldridge asserted that state-wide taxation should support state-aid highway construction as well as funds with which to match Federal-aid money, and that neither counties nor local contributions should be depended upon to supply the latter. He also said he did not believe a uniform Federal-aid law applicable in that many states depended upon Federal-aid funds for earth and gravel construction, whereas richer states should apply those funds to durable types.

Mr. Eldridge does not believe a uniform State-aid law is practicable. Many States, he told the committee, are not applying Federal money to durable types of construction. In Alabama, for instance, 28 per cent of the projects approved, up to Sept. 30, were earth and 34 per cent gravel. In Iowa 66 per cent are earth and 21 per cent are gravel. In many States, he declared, it is questionable whether Federal-aid money should be applied to earth roads.

One of the arguments for devoting more money to the development of certain trunk-line roads, advanced by Mr. Eldridge, is that 10 per cent of the roads of the country carry 90 per cent of the volume of traffic.

Hearings Before Senate Committee on Post Roads

That 85 per cent of all commodities transported in the United States pass over highways at some stage in their distribution is one of the facts brought out at the hearing before the Senate Committee on Post Offices and Post Roads. None of the witnesses appearing is urging any stimulation of road construction at this time, due to the great need for the labor on farms and in the central industries. It is argued, however, that this is a particularly propitious time to formulate better policies with regard to road building. Each witness who has appeared thus far has favored the construction of certain highways to be built and maintained by the Federal Government.

The recent railroad strike has stimulated greatly the interest in highways as it is realized that labor troubles are likely to occur frequently, making rapid transportation of foodstuffs on the highways necessary to prevent famine conditions in centers of population. Among those who have testified before the committee are George C. Diehl, highway engineer, Buffalo; Henry G. Shirley, chief engineer of the Maryland State Roads Commission; Lincoln Tyler, Rotary Club, New York City; A. M. Loomis and J. C. Atchison of the National Grange; Benehan Cameron, president of the Bankhead National Highway Association; and George M. Graham, sales manager, Pierce Arrow Motor Car Co.

New Commerce Commissioners

To fill the vacancy in the Interstate Commerce Commission following the expiration of the term of James S. Harlan and to provide the two additional members called for in the Transportation Act, President Wilson has nominated three new members to the Commission. Nominations have been sent to the Senate naming Henry Jones Ford, James Duncan and Mark W. Potter.

Mr. Ford is professor of politics at Princeton University and from 1872 to his association with Johns Hopkins University in 1906 he was engaged in newspaper work in Baltimore and Pittsburgh.

Mr. Duncan is a vice-president of the American Federation of Labor and has been associated with organized labor since 1881, when he became a local officer in the Granite Cutters' International Association.

Mr. Potter has been president and chairman of the board of directors of the Carolina, Clinchfield & Ohio Ry. since 1907. He entered railway service in 1905 as counsel for the road.

U. S. Engineers to Build Pipe Line in France

Engineers will leave New York this week for France to supervise the construction of an oil pipe line from Le Havre to Paris. Maxime Furland, president of the Compagnie Francaise de Transports des Mazouts et Petroles, to whom the contract for building the line has been awarded by the French Government, has just sailed for France with Wynn Meredith, vice-president of the American Oil Engineering Corporation of New York, which has been engaged by the French concern to do the engineering work. Seton Porter, vice-president of the corporation, states that operations will begin this month and will be completed in about a year.

The new line is designed for carrying a capacity of 24,000 bbl. of oil per day. It will be about 130 miles long and will be similar to the one constructed in California, extending from Coalinga in the San Joaquin Valley to a large refinery on San Francisco Bay. This type of construction will be utilized because the French line will use Mexican crude oil, a heavy oil which must be heated, unlike the oils of the Texas and Oklahoma fields. There will be two pipes, one 25 cm. in diameter for the heavy oils and the other 10 cm. for petroleum.

Most of St. Louis Bonds Defeated

Only five of the eighteen items included in the proposed bond issue for public works at St. Louis received the necessary two-thirds majority at the election on May 11 and they amounted to only $3,750,000 out of the proposed total of $24,000,000. Among the items voted down were $9,000,000 for River des Peres improvement and $2,575,000 for sewers. (See *Engineering News-Record*, Feb. 12, 1920, p. 349.)

Ask for Low Bid on Competitive Bridge Designs

Competitive designs as well as competitive bids are being asked for in the proposals for the new Main St. bridge across the Chemung River at Elmira, N. Y. Four designing engineers were invited to submit designs of the structure, which has to be built within the authorized bond issue. They were governed only by the limiting stresses in steel and concrete and bearing values in piling, except for the necessary requirements of location, etc., and stipulation that the bridge must be of reinforced concrete. Each of these four designs is being checked and reviewed by the city engineer and if any design does not comply with the requirements, its designer does not receive the fee of $500 which is to be given to each of the four, provided his design is satisfactory.

Bids are now being asked on the designs, and it is apparently the intention of the city to award the construction contract to the low bidder. The engineer who made the design upon which award is made receives his designing fee, which is a named percentage of the contract cost of the bridge.

Highway Engineering Fellowships Offered at Michigan

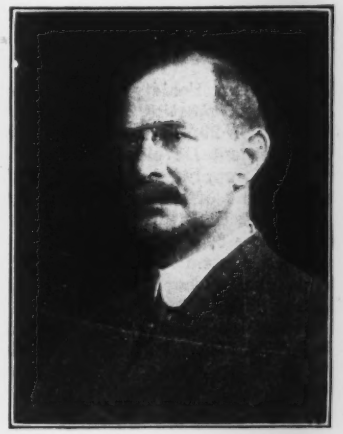
The Department of Civil Engineering at the University of Michigan announces that the following fellowships are available during the collegiate year 1920-1921: The Roy D. Chapin fellowship in highway transport, providing for the investigation of approved subjects relative to highway transport; the Roy D. Chapin fellowship in highway engineering, providing for the investigation of subjects relative to hard surface roads and pavements; and the two Detroit-Edison fellowships in highway engineering open for the investigation of matter concerning the cost of country roads. Each fellowship pays the sum of $250 with an allowance of $50 for expenses.

Applicants for these fellowships must hold a B.A. degree from a college of recognized standing, and must enroll as a candidate for master of science, or master of science in engineering either during the first or second semester or during the winter period from December to March. Applications for fellowships will be received by Arthur H. Blanchard, professor of highway engineering, at Ann Arbor, Mich., not later than Sept. 1, 1920.

R. S. Parsons—General Manager of Erie Railroad

R. S. Parsons, previously chief engineer and recently appointed general manager of the Erie R.R., is one of the railroad engineering heads recently to become the operating head of a large system. Having served as chief engineer during the period of Federal control, Mr. Parsons was appointed general manager over the four regions of the Erie system which were created in the recent reorganization when the railroads were returned to private operation.

Chief Engineer of Railroad Has Been Made Operating Head



R. S. PARSONS

Mr. Parsons has been in the service of the Erie system continuously since his graduation from Rutgers College in 1895, when he entered the engineering department of the road as a transitman. His rise was rapid, and in the following year he was made assistant engineer. Three years later he became division engineer, New York, Susquehanna & Western, and the Wilkes-Barre & Eastern roads. In 1903 he was appointed engineer, maintenance of way, of the Erie, with headquarters at Cleveland.

After serving as engineer, maintenance of way, for three years, Mr. Parsons entered the operating department as assistant general superintendent of the Erie line. A year later he became superintendent of the Susquehanna Division, and in 1910 was transferred to the New York division as superintendent, where he served for three years. He was then made assistant general manager of the Lines East of Buffalo and Salamanca, with headquarters at New York. In 1914 he became general manager of the Ohio Grand Division, later known as the Erie Lines East, with headquarters at Cleveland. In January, 1916, he was appointed chief engineer of the Erie R.R. and in the following September was made assistant to the president and chief engineer. A year later he became assistant to the president and general manager of the Erie Lines, in charge of operation.

Mr. Parsons served as chief engineer during the period of Federal control. When the railroads were returned to private operation the Erie system was reorganized, being divided into four grand divisions over each of which a manager was appointed. Mr. Parsons then became general manager of the entire system and thus the operating head of the lines as a whole.

Census Shows Decline in Rate of City and Town Growth

The aggregate population of 428 cities and towns of the United States, for which the census count for 1920 had been completed up to April 14 as compared with the total population for the same places in 1910 and 1900 has been announced by the Bureau of Census as follows: From 6,323,035 in 1900 to 8,119,182 in 1910, and 9,899,554 in 1920. The percentage increase from 1900 to 1910 was 28.4 against 21.9 from 1910 to 1920. The decline in immigration due to the World War is given by the Census Bureau as doubtless the most important cause for the falling off in the percentage of city growth. The Bureau gives the total immigration to the United States in the last ten years as only 5,431,000, compared with 8,795,000 between 1900 and 1910. The Bureau states that the recent epidemic of influenza probably had some retarding effect on the increase of city population during the past decade. It should be noted that the 1920 census is taken as of Jan. 1, while the 1910 census was as of April 15 and the 1900 census as of June 1. This makes the 1910 census 1½ months short of ten years, and the 1920 census 3½ months short, thus making a difference of about two months between the length of time covered by the 1920 and 1910 census.

Hirst Pleads for Cars to Ship Highway Building Materials

In a letter recently sent to presidents of all the railroads serving Wisconsin, A. R. Hirst, state highway engineer, has protested against the non-shipment of cement for roadbuilding purposes into the state. His letter points out the necessity of free movement of roadbuilding materials in order to carry out Wisconsin's "reasonably possible" program of 140 miles of concrete road. Mr. Hirst says he is sensitive to the fact railroads are now operating under extreme difficulty but nevertheless he believes that in no other way "could more stored productive energy be released with an equal amount of transportation capacity than would be the case if the available supply of cement were quickly released for use." Barred from assistance from the railroads Mr. Hirst predicts the almost total suspension of the building industry with its consequent loss to contractors, laborers, skilled craftsmen and materials producing plants.

C. P. R. Offers McGill Scholarship

Grant Hall, vice-president of the Canadian Pacific Ry., has announced the offering by the railroad of a scholarship covering four years' tuition in architecture, chemistry, civil, mechanical or electrical engineering at McGill University, Montreal. The award, to be made to an employee less than 21 years old or to the minor son of an employee, is subject to a competitive examination to be given at several Canadian cities next June.

Iowa Engineers Voting on State Consolidation

A meeting of delegates from the state and local engineering clubs and societies in Iowa, April 22 and 23, drafted a constitution for a state body which would take the name of the Iowa Engineering Society, but include under a consolidation plan all of the local technical societies and clubs in the state. The plan was proposed at the meeting of the state society in February but delegates from the locals were not at that time willing to accept the constitution as drawn up. In consequence adjourned meetings of the delegates and of the state society were provided for. The latter has approved a constitution which the delegates submitted but it must now be voted on by letter ballot before final ratification.

The various local clubs must also ratify the proposal to become a part of the Iowa Engineering Society before their part of the consolidation is complete. June 1 is the date set for closing the polls.

Essential features in the new constitution are as follows: The objects are to advance engineering knowledge and practice, to promote social and economic welfare, to encourage civic and public service and to maintain a high professional standard among its members. Local engineering clubs are to become district clubs and members of the locals will automatically become members of the state society. A club will elect an applicant to membership in the local, which election will automatically place him on the roll of the state society.

An advisory council composed of the officers of the state society, representatives of the district clubs, and representatives of the members at large, is to hold two meetings annually and handle matters of interest to the profession in the state, initiate policies and devise methods for stimulating the activities of the society. Policies and methods recommended by the council are to be submitted to the annual meeting of the society for approval. If approved, the executive committee, which is composed of the officers of the council, who are officers of the state society, are made responsible for carrying out the recommendations. Dues are $6 for the state organization, plus assessments not in excess of $10 per year by order of the council. The expense of the district clubs is to be determined locally and is additional.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

ORGANIZING CONFERENCE of National, State and Local engineering societies; Washington, D. C., June 3-4.

The Western Society of Engineers, Chicago, at a meeting of its railway section, April 29, listened to a paper entitled "Recent Developments in Railway Water Supply," by C. R. Knowles, superintendent of water service of the Illinois Central R. R. At a general meeting, May 3, a paper on "Santa Fe Apprentice System" was read by F. W. Thomas, supervisor of apprentices, Atchison, Topeka & Santa Fe Ry. By this system the mechanical department has developed and trained a sufficient force to supply shop foremen and master mechanics from its own personnel.

The Seattle Association of Members, Am. Soc. C. E., held its regular monthly meeting April 26. In order to further the activities and interests of the local association, the president had been asked to appoint a number of additional committees. A motion was made and carried, therefore, that he appoint a committee on committees, whose duty it would be to appoint such new committees and outline their activities. A. H. Dimock, as chairman of the committee on the Jones-Reavis bill for a national Department of Public Works, requested interviews from members which he might forward to society headquarters, such interviews to cover duplications of engineering work in Government bureaus which had come to the personal attention of the members. His remarks brought out discussion of the subject, with several instances. T. A. Noble announced that the engineers of Everett, Wash., were taking a more active part than formerly in public affairs and had asked for co-operation from the Seattle Association.

The Ottawa Branch, Engineering Institute of Canada, held a meeting April 21, at which John Murphy, chief electrical engineer, Canadian Department of Railways and Canals, was the speaker. His subject was Canada's ice problems and their solution, illustrated with moving pictures and lantern slides. One interesting and unique feature was a moving picture of frazil and anchor ice in the act of creation.

PERSONAL NOTES

J. E. ENNIS, assistant engineer of rolling stock of the New York Central R.R. under Federal control, has been appointed engineer of equipment claims at New York City. The office of engineer of rolling stock, roadway and structures has been abolished.

L. C. FRITCH, vice-president and chief engineer of the Chicago, Rock Island & Pacific Ry. Co. under corporate control, has been elected vice-president in charge of construction, maintenance and capital expenditures, with headquarters at Chicago.

GEORGE E. BATES has been appointed assistant to the general manager for industrial development of the Delaware & Hudson Co., W. W. BATES, appointed assistant to the general manager for personnel; H. E. BURCH, assistant to the general manager for transportation, and R. J. MCCARTY, JR., superintendent, Saratoga division, all located at Albany, N. Y.

L. C. READ has been appointed city engineer of Sandusky, Mich.

H. R. MULDOON, formerly engineer in charge of road construction for Roane County, W. Va., and THOMAS M. BRADY, of Washington, D. C., in charge of road construction in Walton District, Roane County, announce the opening of a general engineering office at Spencer, W. Va.

ROSS K. TIFFANY has resigned as project manager, U. S. Reclamation Service, to open a consulting engineering office in the Old National Bank Building, Spokane, Wash. He will handle matters pertaining to investigation, organization, construction, betterment, management and finance of irrigation projects. Mr. Tiffany has for the past 19 years been engaged in the irrigation development of the Yakima Valley.

H. N. AIKMAN, recently with Dwight P. Robinson & Co., New York City, has resigned to become engineer in charge of the steel, and a portion of the reinforced concrete, work of the Fargo Engineering Co., Jackson, Mich.

H. M. HADLEY and W. F. MAY have opened an office in the Downs Block, Seattle, Wash., to conduct a general engineering business under the firm name of May & Hadley. During the war Mr. Hadley served with the Emergency Fleet Corporation in the design of concrete ships. Mr. May, who was formerly with the Stone & Webster interests in California and the Alaska Highway Commission, served two years with the 18th Engineers at Bordeaux.

ROBERT CRAWFORD has resigned as superintendent of sewers of Akron, Ohio, to enter the employ of a Cleveland engineering firm.

JOHN B. WRIGHT, formerly captain of Engineers, U. S. A., and con-

...lting highway engineer, of Keene, ... H., has been appointed municipal ...nager of Springfield, Vt.

BENJAMIN F. LATTING, for ...e last two years in charge of the de...gn of steel hangars for the Army Air ...ervice at Washington, D. C., has ac...pted the position of assistant to the ...hief engineer of the Indiana Bridge ...o., Muncie, Ind.

A. P. MILLER, of Glen Miller, Ont., has been appointed assistant engineer on the Trent Canal for the Canadian Department of Public Works.

WILLIAM A. HANSELL has resigned as superintendent of public works of Fulton County, Ga.

GORDON GRANT, formerly chief engineer of the Transcontinental Railway and of the Quebec & Saguenay line, has been appointed chief engineer of highways, under the Canadian Department of Railways and Canals, with headquarters at Ottawa.

KNIGHT, QUALE & GAMER, engineers, of Cleveland and Columbus, have opened offices in Akron, Ohio, specializing in allotment surveys, sewerage and water supply, building construction and power and lighting projects.

PHILIP EARNSHAW, of Kingston, Ont., has been appointed instructor in civil engineering at the Royal Military College, in that city.

R. M. SIAS, engineer of Galveston County, Tex., has resigned to engage in private business in Galveston.

EARL HEBER, general superintendent of the Walsh Construction Co., Davenport, Iowa, who has been in Watertown, N. Y., the past year in charge of the New York Central R.R.'s engine-house and improvements there, has gone to Wilmington, Del., to take charge of the Walsh Co.'s contract for the construction of a $1,000,000 memorial bridge in that city.

JAMES M. STEVENSON has been appointed resident engineer for the Canadian Department of Public Works in the Province of Alberta, with headquarters at Calgary.

JOHN H. MILBURN, office engineer of the engineering department, Baltimore & Ohio R.R., has been appointed by the American Railway Engineering Association a representative of that body on the Advisory Council to the U. S. Board of Surveys and Maps.

PHILIP BURGESS and CHARLES F. LONG, of Columbus, Ohio, have dissolved partnership. Mr. Burgess has entered into a new partnership with CHESTER A. NIPLE and WARREN F. HOPKINS, under the firm name of Burgess & Niple, with offices at 141 East Broad St., Columbus, Ohio.

F. H. DOBSON, formerly general superintendent of the G. A. Fuller Co., and L. O. MAINES, formerly district manager, Philadelphia District, Rust Engineering Co., have incorporated under the name of the Dobson-Maines Co., to conduct a general construction and engineering business, with offices at 49 Conestoga Building, Pittsburgh.

VICTOR PEIMAN, civil engineer, recently in the employ of the Leonard Construction & Engineering Co., of Chicago, as a designer in reinforced concrete, is now with the T. E. McShaffrey Construction Co., which is erecting a large reinforced concrete structure for the Goodrich Rubber Co. at Akron, Ohio.

J. A. S. REDFIELD, division engineer of the Chicago & Northwestern Ry. Co., at Fond du Lac, Wis., has been appointed assistant engineer of maintenance, with headquarters at Omaha, Neb.

OTTO GENGLIN has been appointed city engineer of Texarkana, Tex.

OBITUARY

ALFRED SAMSON, superintendent of the Levis drydock for the Canadian Public Works Department, died at Quebec, April 25.

MAJOR T. H. JONES, city engineer of Brantford, Ont., for 37 years, died in that city April 25.

SAMUEL BUNDOCK, the last of the three principal civil engineers who made the survey for the Northern Pacific R.R., in Montana, died recently at Warm Springs, Mont., at the age of 75.

JAMES EDWIN MILLER, one of the pioneer engineers in Chicago's public improvements, died at Evanston, Ill., April 22. He was born at Laurens, N. Y., in 1831, and went to Chicago in 1856, when he entered the city engineer's office. Later he formed a partnership with the late O. B. Green, and at various times was connected with the design and construction of the city's first water-works crib and first sewerage system on the west side and of the Washington and LaSalle Street tunnels. He was in charge also of the straightening of the Chicago River at its mouth. He then became associated with the firm of Fox & Howard, and after the Chicago fire, with Charles S. Crane, formed the Chicago Dredging & Dock Co., which later was merged with the Great Lakes Dredging & Dock Co.

JOHN C. WINSTON, director of public works of Philadelphia and long known as a leader in municipal reform, died at Germantown, May 6. He was sixty-three years old, was born in Darlington, Ind., and was graduated from Haverford College in 1881. A successful publisher, Mr. Winston became interested also in civic reform, and acted as chairman of the Committee of Seventy organized in Philadelphia. He was appointed chairman of Philadelphia's charter-revision committee. Mr. Winston was responsible for the provisions in the contract and public works clauses of the charter, and particularly for that clause which provides that after 1921 Philadelphia shall do its own street cleaning, unless the work is awarded to private contractors by a majority vote of council. Upon the election of Mayor J. Hampton Moore, Mr. Winston, last December, was appointed director of public works.

ALEXANDER VON BABO, engineer of bridge design in the Chicago Department of Public Works, died April 29. He was born at Heidelberg, Germany, in 1854, and studied at the Polytechnic School of Karlsruhe and the University of Berlin, receiving his diploma as civil engineer at the former institution. In 1881 he went to Canada, in the employ of Blanchard & Wilson, surveyors, at Winnipeg. The following year he entered the Chicago office of the Delaware Bridge Co., after which for short periods he was at Indianapolis, with W. Sherrer, architect for the Indiana state capitol, engaged in the structural steel design; with the Iron City Bridge Works, Pittsburgh; in the city engineering department of Chicago under Samuel Artingstall, city engineer; the Union Bridge Co.; with Geo. S. Morison and Morison & Corthell. In 1888 he became the representative in this country for the German electrical engineering firm of Siemens & Halske. He again entered the engineering department of the Chicago Department of Public Works, as engineer in bridge design, in 1899, and retained practically the same position up to the time of his death. Mr. von Babo assisted in the design of the Chicago type of trunnion bascule bridge and invented the operating system, which consists of a pinion and concave rack, as noted in *Engineering News-Record* of April 8, 1920, p. 720. In 1902 he designed the first temporary bridge with pontoon draw for use while rebuilding bridges over the Chicago River (see *Engineering News*, Jan. 11, 1906, p. 43). He was a member of the Western Society of Engineers.

BUSINESS NOTES

THE M. B. SUYDAM CO., Pittsburgh, has opened an office at Buffalo, N. Y., under the supervision of James M. Hawkins.

CHARLES E. MORRELL, JR., has resigned as superintendent of construction, U. S. Public Health Service, to take a similar position with the Gallivan Building Co., Greenville, S. C.

E. G. LEWIS, formerly manager, Cleveland office of the Bucyrus Co., has been appointed central sales manager, with headquarters in the McCormick Building, Chicago. He succeeds E. C. Hingston, resigned. The Cleveland office will be continued under Mr. Lewis' jurisdiction.

L. D. SHEPPARD has resigned from the construction department of Day & Zimmermann, Inc., Philadelphia, to become superintendent for Everett Winters, general builder, Detroit, Mich.

J. W. HOLMAN, for several years connected with the Robert Grace Contracting Co. and the Mellon-Stuart Co., Pittsburgh, is now associated with the Culbertson Construction Co., with offices in the Stambaugh Building, Youngstown, Ohio.

STANDISH & ALLAN, engineers and contractors, Chicago, announce the association with their firm of Jerome F. Wilhelm, formerly of the Union Bridge & Construction Co. of Kansas City. The firm will continue to operate under the name of Standish & Allan. Mr. Wilhelm will have charge of all pneumatic foundation work.

THE LOS ANGELES SHIPBUILDING & DRY DOCK CO., San Pedro, Cal., has added to its executive staff James Reed, recently commander of Construction Corps, U. S. Navy, as assistant general manager. For the past six years Mr. Reed has been New York superintendent, Hull Division, Mare Island Navy Yard, in connection with tanker, destroyer and battleship construction.

THE PATTON CLAY MANUFACTURING CO., Patton, Pa., has become a licensee of the Dunn Wire-Cut Lug Brick Co., of Conneaut, Ohio, and will engage in the manufacture of wire-cut lug paving brick.

THE DETROIT GRAPHITE CO., Detroit, Mich., announces the election of J. W. Austin as its assistant secretary. He will also direct the purchasing policy for the Detroit and allied Canadian plants of the company.

THE CHAIN BELT CO., Milwaukee, Wis., announces the appointment of H. S Rosenthal, formerly of the Waterloo Construction Machinery Co. and the Clyde Iron Works, as its Southern district sales manager for "Rex" mixers and pavers. He will have complete charge of the sales in Texas, Arkansas, Louisiana, Mississippi, Alabama, Florida and Tennessee.

Safety Bolt Breaks With Overload, Stopping Crusher

A new stone crusher, developed in Sweden during the war, incorporates a new detail in design which insures safety against overload. In this machine the power is transmitted from the crank shaft to the oscillating jaw through an unequal arm lever, and through a roller mounted between the main roller and the jaw. The jaw forms the concave face upon which the roller operates without sliding friction and without need of lubrication. The lever is constructed in two parts, kept together by a hinge and by a safety bolt arranged to break for an overload, caused for instance by the lodgment of a sledge hammer between the jaws. When such an overload occurs and the bolt breaks, the motion of the lower part of the lever is stopped. The upper part of the level continues to move, swinging on the hinge until the motive power is shut off and a new safety bolt inserted. The safety bolt is turned with a narrow incision to a certain depth, leaving the bolt strong enough to stand any normal strain. Under the head of the bolt is placed a cupped disk of hardened steel designed to deflect more than the bolt stretches.

The crusher, which has been used extensively for crushing road material, is described in a recent letter from Gustaf Rennerfelt, of Stockholm, Sweden, who claims for his invention over other stone crushers higher efficiency, less need of lubrication, and particularly safety against overload.

New Tractor Makes Appearance

A 7½-ton four-wheel-drive tractor, designed and developed for us in logging camps, mines, oil fields, plantations and among other industries where there are insufficient or no transportation facilities has just appeared on the market by the Rogers Tractor & Trailer Co. of Albion, Pa. The manufacturers have incorporated in the machine a four-cylinder Buffalo gasoline motor, with a 6¾-in. bore, 9-in. stroke. It is capable of developing 98 hp. It has a sliding gear transmission which was a design and construction of the Rogers Co., two speeds being provided forward and two speeds reversed. Power, transmitted to the drive wheels by bull pinions, is delivered without the use of a single universal joint. These wheels, 48 in. in diameter, with a 24-in. face, are equipped with fifteen 3-in. channels ⅞ in. thick, to provide traction.

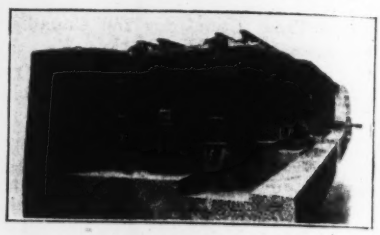
NEW TRACTOR CROSSING STONE BARRIER

The manufacturers claim that any one of the four wheels of the tractor can be raised up to 5 ft. from the ground without throwing any gears out of alignment or causing any friction. The front wheels can be tipped at one angle and the rear wheels at the opposite angle, as the frame is constructed in two separate parts, though hinged in order to permit oscillation.

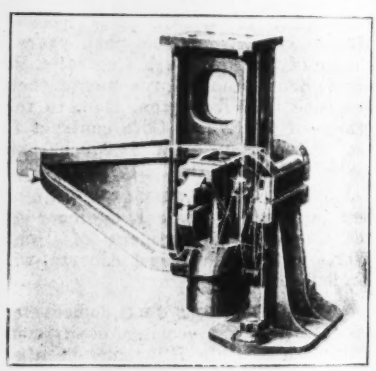
Track Scale Embodies New Features

A track scale embodying new features has been placed on the market partly as a result of the new specifications adopted jointly by the American Railroad Association, the American Railway Engineering Association, and the Bureau of Standards.

The new specifications make necessary such changes in design that scales in accord with them will not be interchangeable with old scales, and this occasion was taken to make other departures from previous standard design. In the design of the scale as shown in the accompanying cut the *I* section levers were abandoned and double web section is used for all of the levers in the scale. The connections between levers of the standard *I* section must be made between pivots projecting from both sides of the levers, with the assumption that load is applied along the center of each bearing and transmitted along the center line of the connecting lever. Hence, if load on both sides is not equal, a torsional strain is produced in the lever. In the new scale initial load is suspended from the center of the main lever bearing, as shown in the cut. From that point it is transmitted to the true center line of the lever to each succeeding bearing, and the tip of one main lever of each pair is directly over or below the true center line of the opposite lever so that the combined pull of both is on a straight line to the center of the bearing.



SCALE HAS WEB SECTION LEVERS



MAIN BEARING CONSTRUCTION

The new scale is built in two capacities for light duty service or such service requiring the weighing of a relatively small number of cars. It is made by E. & T. Fairbanks & Co., St. Johnsbury, Vt.